UNDERSTANDING INTENTION TO USE TELEREHABILITATION:

APPLICABILITY OF THE TECHNOLOGY ACCEPTANCE MODEL (TAM)

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## شكر وتقدير

أتوجه بالحمد والشكر أولا إلى الله المولى عزل وجل اللذي هداني و سهل لي طريق إعداد هذا البحث. ثم أتقدم بالشكر لجامعة ولاية إنديانا الأمريكيه وكلية العلوم التأهيلية والصحيه, وللجنتي للتوجيه الأكاديمي, ولمرشدي الأكاديمي, ولرئيس قسم العلوم الصحية لقبولي في البرنامج وإعطائي الفرصة لتحقيق أهدافي الأكاديميه والبحثيه. أتقدم أيضا بخالص الشكر لأعضاء لجنة البحث وذلك لدعمهم الدائم والمستمر خلال مسيرة إعداد بحثي. كما أشكر جامعة الإمام عبدالرحمن بن فيصل بالدمام لمنحي فرصة الإبتعاث, وأعضاء قسم الرعاية التنفسية الموقرين, وأستاذي معالي الدكتور عبدالله الربيش واستاذي الدكتور غازي العتيبي وذلك لإيمانهم في إمكانيه إنجازي لهذا البحث ودعمهم المستمر لي.

أتقدم أيضا بخالص الشكر لأبي وأمي, وأخويي الإثنين, وأخواتي الثلاثه,وأقربائي, وأصدقائي لدعمهم المستمر ودعواتهم الصادقة لي.

كما أتوجه بجزيل الشكروالتقدير لزوجتي وطفليَّ (مقبل وليان) لدعمهم لي ولتحملهم مشاق فترة الدراسة والبحث والإغتراب وتفهمهم لفترات الإنشغال عنهم.

Abdullah Almojaibel

UNDERSTANDING INTENTION TO USE TELEREHABILITATION: APPLICABILITY OF THE TECHNOLOGY ACCEPTANCE MODEL (TAM)

Background: Pulmonary rehabilitation (PR) has the potential to reduce the symptoms and complications of respiratory diseases through an interdisciplinary approach. Providing PR services to the increasing number of patients with chronic respiratory diseases challenges the current health care systems because of the shortages in health care practitioners and PR programs. Using telerehabilitation may improve patients' participation and compliance with PR programs. The purpose of this study was to examine the applicability of the technology acceptance model (TAM) to explain telerehabilitation acceptance and to determine the demographic variables that can influence acceptance.

Methods: A cross-sectional survey-based design was utilized in the data collection. The survey scales were based on the TAM. The first group of participants consisted of health care practitioners working in PR programs. The second group of participants included patients attending traditional PR programs. The data collection process started in January 2017 and lasted until May 2017.

Results: A total of 222 health care practitioners and 134 patients completed the survey. The results showed that 79% of the health care practitioners and 61.2% of the patients reported positive intention to use telerehabilitation. Regression analyses showed that the TAM was good at predicting telerehabilitation acceptance. Perceived usefulness was a significant predictor of the positive intentions to use telerehabilitation for health care providers (OR: 17.81, $p < .01$) and for the patients (OR: 6.46, $p = .04$). The logistic regression outcomes showed that age, experience in rehabilitation, and type of PR increased the power of the TAM to predict the intention to use telerehabilitation among health care practitioners. Age, duration of the disease, and distance from the PR center increased the power of the TAM to predict the intention to use telerehabilitation among patients.

Conclusion: This is the first study to develop and validate a psychometric instrument to measure telerehabilitation acceptance among health care practitioners and patients in PR programs. The outcomes of this study will help in understanding the telerehabilitation acceptance. It will help not only to predict future adoption but also to develop appropriate solutions to address the barriers of using telerehabilitation.

Niki Munk, PhD, LMT, Chair

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# Chapter I: Introduction

This section provides an overview of chronic respiratory diseases (e.g., chronic obstructive pulmonary disease (COPD), asthma, and cystic fibrosis), pulmonary rehabilitation (PR), and pulmonary rehabilitation using telehealth (telerehabilitation). This will be followed by a discussion of the theoretical framework of the research that defines telerehabilitation as a chief facilitator for the International Classification of Functioning (ICF), Disability, and Health Model. This chapter will be concluded with a statement of the problem, purpose and significance of the study, and research aims.

## Chronic Respiratory Diseases

Chronic respiratory diseases which include chronic obstructive pulmonary disease (COPD), asthma, occupational lung diseases, and cystic fibrosis, constitute a serious health and economic concerns in societies across the world ("WHO | About chronic respiratory diseases," 2011). Chronic respiratory diseases are among the most challenging diseases for health care practitioners to care for because of the wide-ranging impacts on patients' medical, social, and economic status (Epping-Jordan & World Health, 2002). Designing a treatment plan for patients with these diseases should aim at improving their well-being and functional status. PR plays an essential role in the treatment plan for those with chronic respiratory diseases and is recommended for all patients with chronic respiratory diseases who are suffering from persistent symptoms, reduced exercise ability, and limited activity. PR may also be used as a facilitator for coping with illness after maximizing medical management. Even though the literature concentration in the pulmonary rehabilitation in patients with COPD, those with secondary respiratory impairments as caused by other non-respiratory diseases may also join PR programs and benefit from PR processes (Hodgkin, Celli, & Connors, 2009). A list of the medical conditions that could be considered for PR is shown in Box 1.

Box 1
*Conditions Appropriate for Pulmonary Rehabilitation.*

Obstructive Diseases

- COPD
- Persistent asthma
- Cystic fibrosis
- Bronchiectasis

Restrictive diseases

- Interstitial fibrosis
- Occupational or environmental lung disease
- Kyphoscoliosis
- Diaphragmatic dysfunction
- Multiple sclerosis

Other conditions

- Lung cancer
- Primary pulmonary hypertension
- Before and after thoracic and abdominal surgery
- Before and after lung transplantation
- Ventilation dependency
- Pediatric patients with respiratory disease (Hodgkin et al., 2009).

**Pulmonary Rehabilitation**

Pulmonary rehabilitation (PR) reduces symptoms and complications of respiratory diseases through an interdisciplinary approach. These interventions used often include education about the disease, exercises geared towards the strengthening of cardiopulmonary muscles, and psychological support. Among the advantages of PR is that it optimizes the functional status and the patient's health related life's quality (McCarthy et al., 2015). Additionally, PR can reduce the cost of health care services through stabilization or reversal symptoms caused by the illness (Spruit et al., 2013). It also does so by decreasing cases of emergency visits or time that patients are admitted due to chronic pulmonary diseases (Golmohammadi, Jacobs, & Sin, 2004).

Providing PR services to the increasing number of patients with chronic respiratory diseases challenges the current health care systems because of the shortages in health care practitioners and PR programs (V. A. Wade, Eliott, & Hiller, 2014). As of August 2017, only 841 certified pulmonary rehabilitation (PR) programs provide PR services in the United States of America ("AACVPR Online Searchable Program Directory," 2015). The number of programs available is inadequate to cater for the rehabilitation requirements of an ever increasing number of patients with chronic respiratory diseases. Even in areas where PR programs are available, they are underutilized (X. L. Liu et al., 2014). Keating, A., Lee, A., & Holland, A. E. (2011) found that the percentage of nonattendance in PR ranged from 8.3 to 49.6%, and non-completion ranged from 9.7 to 31.8%. The reasons for low utilization rates were established to be poor access to PR programs, inadequate transportation channels, as well as conflicting time schedules with the patient's programs. Modern models of delivering health care services, such as telehealth or telerehabilitation, may improve patients' participation and compliance with PR programs.

**Telehealth and Telerehabilitation**

*Tele* comes from the Greek for 'at a distance' so telehealth is the provision of health care at a distance (Brownsell, 2009). Telehealth refers to the concept of using telecommunication technology together with electronic information to enable remote clinical health care, public health, patients and professional health-related education. It is also used to aid in remote health administration ("Telehealth," 2015). Telerehabilitation, therefore, emerges as a method of delivering rehabilitation services to patients at a distance utilizing the Internet and telecommunication technology (Tang, Mandrusiak, & Russell, 2012).

Telerehabilitation involves diverse clinical disciplines such as respiratory care, occupational and physical therapy, neuropsychology, and cardiac and pulmonary rehabilitation. However, types of interventions can vary based on clinical needs and may include direct service delivery, specialist consultations, and remote monitoring (Brennan & Barker, 2008). Even though not all PR services can be delivered to patients at home using telerehabilitation, key rehabilitation services have been delivered successfully to patients remotely. As concluded in a systematic review conducted by Almojaibel (2016), multiple PR modalities such as pursed lip breathing technique training, supervised cardiopulmonary exercise, and disease related education sessions could be provided via telehealth for patients at home (Almojaibel, 2016).

Telerehabilitation has many potential benefits for patients and the health care system in general. Using telerehabilitation to supervise ongoing remote PR can minimize patients' anxiety, ensure that prescriptions are carried out accurately, and help patients' recovery progression (Tang et al., 2012). Moreover, telerehabilitation includes the use of electronic health record systems and vital sign monitoring devices that could increase efficiency and quality of care for patients with chronic respiratory diseases at home. One of the potential benefits of implementing telerehabilitation programs is cost reduction through early discharge. Patients enrolled in telerehabilitation could be discharged earlier from the hospital, and the health care support from the telerehabilitation team could prevent avoidable readmissions through home monitoring and home-based telerehabilitation sessions.

## Theoretical Framework

**The ICF Model (International Classification of Functioning, Disability, and Health).** This is a model contributes a standard language to define and measure health and disability. This standardized language helps to understand and study both health and health-related issues. The ICF domains are categorized into two parts. Each part has two components Part 1: Functioning and Disability: a) Body Functions and Structures, which includes two classifications: one for functions of body systems and one for body structures, b) Activities and Participation, which includes all aspects of functioning about an individual or the social perspective. Part 2: Contextual factors: c) Environmental Factors, d) Personal Factors (Figure 1) (World Health Organization, 2001).

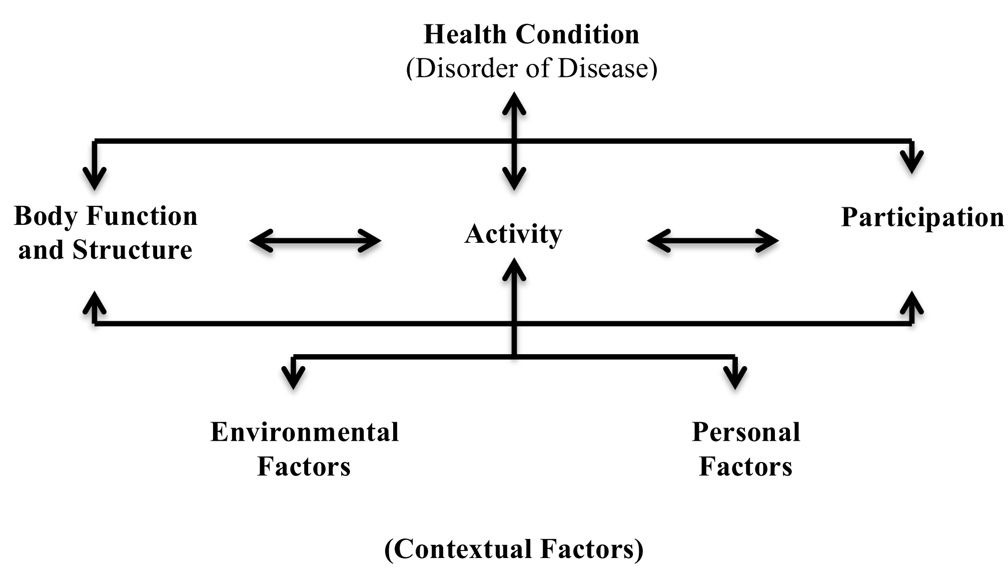


Figure 1. The International Classification of Functioning, Disability, and Health (ICF) model.

**Telerehabilitation and the ICF.** Using telerehabilitation could be an enhancement to ICF via many means (Figure 2). Telerehabilitation could be used as a facilitator for the patient's body structure and functioning, the prevalent environmental conditions, or the combined events. Telerehabilitation could enhance the working of various systems which include hematological, respiratory, cardiovascular, and immunological systems. Specifically, PR has the potential to help to improve functions of the respiratory system for the patients. Respiratory functions improved by PR, include inhalation, gaseous exchange, and exhalation (category b440 of the ICF). The category b440 of the ICF includes respiration rate (b4400), respiration rhythm (b4401), depth of respiration (b4402), and respiration functions, other specified (b4408), and respiration functions, unspecified (b4409). Other respiratory functions include its muscle functions (b445). This denotes the activity of thoracic muscles (b4450), the diaphragm (b4451), action of the necessary respiratory muscles (b4452), respiratory muscles, any other specified (b4458), as well as any unspecified (b5559) (World Health Organization, 2001).

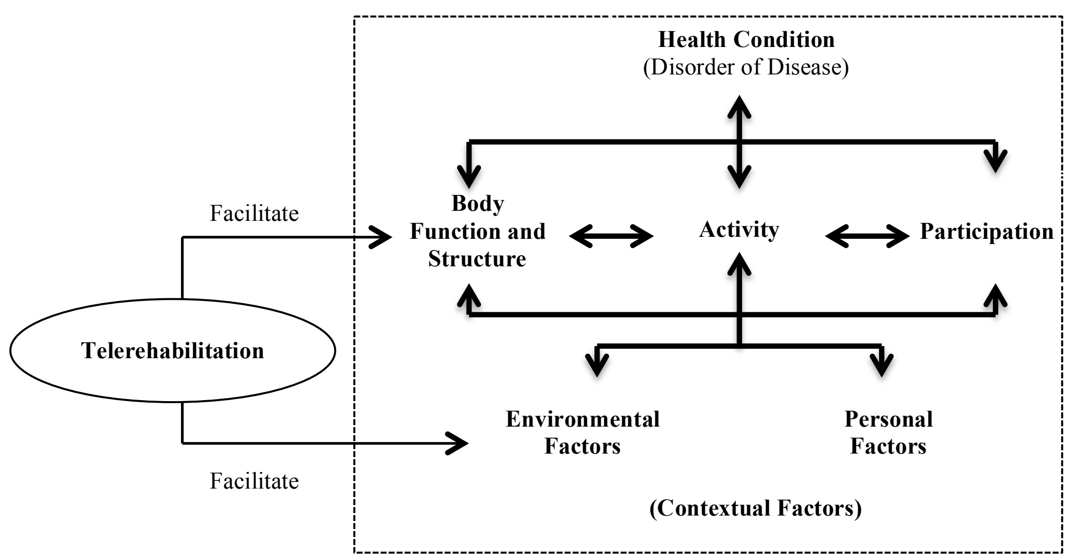


Figure 2. Telerehabilitation and ICF.

PR is used to enhance the functionality of the patients' cardiovascular and respiratory systems. This includes those functions that are associated with breathing which include a cough, sneeze, and yawn (b450), as well increasing tolerance to exercise (b455). The exercise tolerance incorporates the respiratory and cardiovascular ability required to endure any level of physical exertion. This includes the patient's general endurance to physical activity (b4550), their aerobic ability (b4551), the level of fatigability (b4552), the exercise tolerance functions that are specified (b4558), as well as exercise tolerance functions that are unspecified (b4559) (World Health Organization, 2001).

Telerehabilitation as a way to provide PR services for patients at home could be classified under the e125 section of the environmental factors of the ICF. The e125 'products and technology for communication' include "products, equipment, and technologies that can be utilized for sending and receiving information. They include facilities adapted through special design, location for use by the person using them" (World Health Organization, 2001, p. 175). The telerehabilitation system could be classified specifically under the category e1250 "general products and technology for communication," or under the category e1251 "assistive products and technology for communication." For example, participants in the telerehabilitation programs could utilize off-the-shelf videoconferencing software to send and receive disease related educational materials or for real-time communication between patients and health care practitioners in the PR center. Moreover, when using telerehabilitation to provide health related education, telerehabilitation could also be classified under category e130 "products and technology for education." This category covers " equipment, products, processes, methods, and technology used in the process of acquiring knowledge, expertise or skill in a particular field" (World Health Organization, 2001, p. 175). Using telerehabilitation for providing educational sessions could also be categorized under the category e1301 if the telerehabilitation system is specially designed (World Health Organization, 2001).

Telerehabilitation could be used to modify the environmental factors of patients with the chronic respiratory diseases. Poor access to PR programs, occasioned by inadequate transportation or a conflicting schedule of PR programs are all factors that prevent patients from attending PR programs (Keating et al., 2011). Telerehabilitation allows health care practitioners to provide high quality and cost effective rehabilitation services for patients at their homes despite the existing barriers. Telerehabilitation could be used to help patients receiving rehabilitation services without the difficulties and the high cost associated with transportation. Also, receiving rehabilitation services at home using telerehabilitation could improve participation and adherence because PR sessions can be scheduled online based on patients' preferences.

Interaction amongst ICF constructs is dynamic. Changing one construct may thus affect other constructs or the whole model indirectly. Using telerehabilitation could improve patients' health status directly or indirectly. For example, improving the patient's environmental factors by providing education about breathing techniques through telerehabilitation could facilitate respiratory functions, and ultimately could facilitate the patients' exercise tolerance functions. However, to ensure success for any new telerehabilitation program, measuring determinants of accepting telerehabilitation among potential users is needed. Identifying the determinants of telerehabilitation acceptance will help stakeholders in the health care system to know when, where, and how to apply the telerehabilitation and successfully implement its programs.

### Statement of Problem

Using telehealth for PR (telerehabilitation) is a new field of health care practice. Potential users' uncertainty and misperceptions regarding telehealth are barriers to its implementation (Brewster, Mountain, Wessels, Kelly, & Hawley, 2014). To successfully establish a new telehealth program, the human factor must be accounted for as well as software and technology aspects. Therefore, to successfully implement a telerehabilitation program, determinants of acceptance need to be assessed among potential users. However, the potential factors influencing health care practitioners and patients' intention to use telerehabilitation in PR programs are not known. Measuring telerehabilitation acceptance determinants will help telehealth developers design better systems that consider patients' and health care practitioners' needs.

### Purpose and Significance of the Study

**Purpose.** This study examines the potential factors that may influence acceptance of telerehabilitation among potential users. Often referred to as the TAM, the study will utilize the technology acceptance model as the theoretical framework for its measurement tools (Fred D. Davis, 1989). The goal is to examine whether the TAM is useful in explaining telerehabilitation acceptance among health care practitioners and patients. The study will also examine the demographic variables of potential users associated with high acceptance of telerehabilitation. A cross-sectional survey-based design was utilized in the data collection from health care practitioners and patients attending PR programs. Data collection will be followed by psychometric evaluations of the extent to which the modified TAM scale can be deemed to have evidence of validity and reliability. The next step involved multiple regression analyses to determine the demographic variables that influence the intention to use telerehabilitation.

**Significance.** PR is recommended when treating patients suffering from chronic respiratory diseases. It has been associated with improved health-related quality of life (HRQOL), respiratory muscle strength, and exercise capacity. PR could reduce number of hospitalizations and visits to the emergency department (detailed discussion of PR benefits is in Chapter II). Keating et al. (2011) found that only 1.5 % of COPD patients receive PR services annually. Even in areas where PR programs are available, PR programs are underutilized. Reasons for the low utilization include poor access and inconvenient timing of the rehabilitation sessions (Keating et al., 2011). Facilitating tools such as telerehabilitation has been proposed as a method of providing PR services for patients at home. Using telerehabilitation could be a solution for shortages in PR programs, low attendance rates among patients, and can improve patients' participation and compliance to PR programs.

Using telehealth for PR is in its beginning phase. This situation highlights the need to understand the intentions of the potential users to use this technology before implementation. Identification of the variables that may affect the intention to use telehealth is needed to ensure program success, patients' compliance, and positive outcomes (Kowitlawakul, 2011). In the context of using telerehabilitation, the determinants of positive intention to use telerehabilitation are still not well studied. A small body of research has explored acceptance of using telehealth in general. A review of these studies showed limitations in their scopes, theoretical foundations, and limited generalizability. The published studies examined acceptance of different technologies such as landlines and store-and-forward telecommunication technologies (Gagnon, Orruño, Asua, Abdeljelil, & Emparanza, 2012; Rho, Choi, & Lee, 2014; Taylor et al., 2015; Zailani, Gilani, Nikbin, & Iranmanesh, 2014). Few studies explored acceptance of using telehealth among patients with chronic respiratory diseases. Most of them focused only on participants' perceptions after using telehealth (J. P. Chau et al., 2012; J. Finkelstein, Hripcsak, & Cabrera, 1998; Nikander et al., 2010). Previous studies investigated neither health care practitioners' nor patients' acceptance of using the telerehabilitation systems. In particular, the literature lacks answers to the following question: What are the factors that influence the intention to use telerehabilitation among potential users, both health care practitioners and patients?

This study will fill the gap regarding understanding the determinants of positive intention to use telerehabilitation among health care practitioners and patients. This study will use the technology acceptance model (TAM) as a theoretical framework to measure the determinants that may influence the intention to use telerehabilitation among health care practitioners and patients. The study will also explore the influence of the demographic variables on the intention to use telerehabilitation. The prime objective of conducting the research is to answer the following questions:

1) What are the main factors that might influence the intention to use telerehabilitation?
2) What are the demographic variables that could influence the intention to use telerehabilitation?

The outcomes of this study will help to have a comprehensive model that can facilitate a better understanding of the telerehabilitation acceptance. This research is intended to make a significant contribution to the literature because no previous study has measured the potential users' intention to use telerehabilitation. Determining the factors that might influence telerehabilitation acceptance is needed to maximize telerehabilitation usage, enhance the quality of care and outcomes, and decrease expenses of initiating telerehabilitation programs.

**Research Aims**

The specific aims of this study are:

1- To develop and psychometrically test the Tele-Pulmonary Rehabilitation Acceptance Scale for validity and reliability.
2- To identify the significant demographic variables influencing the intention to use telerehabilitation among health care practitioners and patients.

**Summary**

Using telerehabilitation is a new practice within PR field. Telerehabilitation can be used to help PR programs improve access and achieve better outcomes. Understanding the factors that may affect potential users' in their decision to use or not use telerehabilitation is a key factor in success. This study, therefore, examines the detriments to positive intention in the use of telerehabilitation among health care practitioners and patients by using the TAM constructs perceived usefulness and perceived ease of use. The outcome of this study (the modified TAM scale) will help in identifying the determinants of positive intention to use telerehabilitation. Identifying the determinants of telerehabilitation acceptance will help decision makers to decide when, how, and where to initiate telerehabilitation programs in PR centers.

# Chapter II: Review of the Literature

## Overview

The following section will cover the definitions, causes, and burdens of three common respiratory diseases: asthma, cystic fibrosis (CF), and COPD.  A discussion on the benefits of PR to patients with different respiratory conditions will follow.  Also, this chapter will discuss the benefits of attending pulmonary rehabilitation (PR) programs for patients waiting for lung transplantation or after lung transplantation surgery.  This chapter will discuss the barriers that patients with chronic respiratory diseases face when attending a PR program and propose how to improve attendance in PR programs.  An overview of the outcomes of using telehealth for patients with respiratory diseases will follow.  Moreover, this chapter will include a systematic review of studies that applied telerehabilitation in the provision of real-time PR services in managing COPD.  Finally, this chapter will include a systematic review of studies that explored telehealth acceptance among health care practitioners and patients.

## Chronic Respiratory Diseases

Respiratory diseases affect the airways and other structures of the lungs (e.g., COPD, asthma, and CF).  Chronic respiratory diseases affect millions of people's quality of life and physical abilities across the world.  Chronic respiratory diseases affect the patients economically and could also cause death (Cruz, Bousquet, & Khaltaev, 2007). The World Health Organization (WHO) establishes economic barriers, cultural barriers, environmental barriers, and poor access to care as factors that may reduce the availability and affordability of care among those suffering from chronic respiratory diseases (Cruz et al., 2007). This section will concentrate on chronic respiratory diseases COPD, asthma and CF, and their prevalence and economic burdens.

**Chronic obstructive pulmonary disease (COPD).** The Global Initiative for Chronic Obstructive Lung Disease (GOLD) defines COPD as “a disease characterized by partially reversible airflow limitation. Airflow limitation happens progressively with correlation to abnormal lung’s inflammation occurring as a result of inhaling noxious gases and particles.” (Gómez & Rodriguez-Roisin, 2002, p. 81). COPD is a common cause of death in many industrialized countries. In the United States, COPD attributed to 119,054 of the deaths in 2000. More than half of patients with COPD reported that COPD conditions distracted sleep. COPD also decreased capacity to perform physical exercises, work, and participate in and social activities ("Chronic Obstructive Pulmonary Disease (COPD) Fact Sheet - American Lung Association," 2015). In 2010 there was an estimated approximately $49.9 billion annual cost in expenditure spent on caring for patients with COPD. A total of $30 billion was the direct cost of the health care expenditures such as detection, treatment, prevention, and on rehabilitation programs, $8 billion was the indirect cost (morbidity), and $12 billion was the indirect mortality costs (Guarascio, Ray, Finch, & Self, 2013).

**Asthma.** Asthma is one of the major non-communicable respiratory diseases, with reversible airflow obstruction caused by airway inflammation and tightening of those muscles around them. Asthma affects approximately 235 million people of all ages and races worldwide ("WHO | Asthma," 2014). The Centers for Disease Control and

Prevention (CDC) reports that from 2001 to 2010, asthma cases reported in the U.S. rose from 20.3 million to 25.7 million cases (Moorman et al., 2012). The prevalence was estimated to be 17.2 million (8.7%) adults in 2010 (Centers for Disease Control Prevention, 2013). In the United States, asthma costs about $19.7 billion each year (American Lung Association, 2008).

**Cystic fibrosis (CF).** CF is a chronic disorder affecting how exocrine glands functions by causing thick mucus to form in the airways. CF manifests characterized by repeated endobronchial infections, an exaggerated inflammatory response, airway obstruction, and bronchiectasis (Volsko, 2009). CF is a challenging chronic pulmonary disorder. In the 1950s, few patients with CF survived to elementary school age. In 2007, the predicted survival age for patients with CF improved to be 37.4 years (American Lung Association, 2008). Typically, the families of CF patients provide the majority of the clinical care to their CF family members at home, which includes airway clearance techniques, prevention and management of infection, and providing the proper nutrition (American Lung Association, 2008).

## Pulmonary Rehabilitation

The American Thoracic Society (ATS) and the European Respiratory Society (ERS) defines pulmonary rehabilitation as:

> A comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies stretching across, education exercise training, and behavior change, designed to improve the physical and psychological condition of people suffering from chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors. (Spruit et al., 2013, p. 16)

A successful PR program should be an interdisciplinary program that includes experts from different health care disciplines. The interdisciplinary team in PR may involve physicians, nurses, psychologists, respiratory therapists, physical therapists, and others if the team requires additional expertise. This group of experts will collaborate to meet the patient's needs individually. A successful PR program should pay equal attention to the physiological, emotional, and social issues of each patient (Ries et al., 2007).

PR could benefit patients with chronic respiratory disease in different ways. These benefits include a reduction in dyspnea, improvement in exercise capacity, and improvement in mental health. According to joint ACCP/AACVPR evidence-based clinical practice guidelines, PR has the potential to improve health-related quality of life (HRQoL), reduces hospitalizations and number of hospitalization days per COPD patient (Ries et al., 2007).

**Benefits of pulmonary rehabilitation.**

*Benefits of the physical training.* Physical training is an important part of any PR program. Intensity, duration, and frequency of exercise training should be tailored specifically for each patient, and it should be increased gradually to achieve the set goals. Usually, exercise training includes lower and upper extremities training. Lower-extremity training is recommended for all PR participants, and it can be performed using treadmill walking or stationary cycling. Troosters, T., Gosselink, R., & Decramer, M. (2000) investigated the effects of a 6-month outpatient rehabilitation program. Participants were randomly assigned to either the intervention group that participated in cycling, walking, and strength training, or to the control group. Study results showed significant improvements in the 6-minute walking test, respiratory muscle strength, and HRQoL for patients within the intervention group. Also, Holland, A. E., Hill, C. J., Nehez, E., & Ntoumenopoulos, G. (2004) compared the effects of upper and lower extremities training with the effects of lower limbs only on COPD patient's capacity for exercises, HRQoL, symptoms of the disease. Holland et al. concluded that upper limb training improved upper limb exercise capacity but showed no effects on symptoms or quality of life, in comparison to lower limb training alone. Moreover, Costi, S., Crisafulli, E., Antoni, F. D., Beneventi, C., Fabbri, L. M., & Clini, E. M. (2009) explored the effects of unsupported upper extremity exercise training (UEET) in patients with COPD. Patients in the intervention group received the traditional PR services plus the unsupported UEET, while the control group received the PR services without the UEET. The study results showed improvements in the 6-minute ring test and Activities of Daily Live (ADL) test for the intervention group in relation to the control group. Costi and colleagues concluded that for patients with COPD unsupported UEET is effective in improving functional exercise capacity.

Patients with COPD have weak respiratory muscles that may cause dyspnea and decreased exercise tolerance. Inspiratory muscle training can increase inspiratory muscle strength, decrease dyspnea level, increase exercise tolerance, and improve the HRQoL of COPD patients (Carlin, 2009). O'Brien, K., Geddes, E. L., Reid, W. D., Brooks, D., & Crowe, J. (2008) explored impacts associated with inspiratory muscle training (IMT) singly or combined with exercise and PR in patients with COPD. This review concluded that performing both IMT and exercises may improve inspiratory muscle strength and may increase inspiratory muscle endurance.

***Cost effectiveness of PR.*** Economic studies have evaluated the role of PR in decreasing the utilization of health care resources. Griffiths et al. (2000) observed a group of 200 patients who were randomly assigned to either standard medical management or a 6-week rehabilitation program. This study assessed the use of health care services and found no statistical difference in patients admitted to hospital between the two groups. There was, however, a significantly higher number of admission days spent by patients in the standard medical group. The average decrease in bed occupancy for patients in the rehabilitation group was up to 4 days per patient. The cost-utility economic analysis in this study indicated that using PR was cost-effective. In another study conducted in Canada, an economic assessment of the PR program found a reduction of approximately 340 Canadian dollars ($p$ = .02) in the total cost per patient after one year. The savings in the total cost of PR were caused by reductions in emergency visits and reduction in days of admission up to 89% compared to before the PR program (Golmohammadi et al., 2004). Furthermore, in a randomized clinical trial conducted by Bourbeau et al. (2003), education sessions on self-management decreased hospital admission periods, emergency department visits, and unscheduled-physician visits for patients with COPD.

## Pulmonary Rehabilitation for Patients other than COPD

Usually, the majority of PR participants are patients with COPD. However, patients with other chronic diseases who experience the same respiratory symptoms that affect their health and daily activities can also benefit from PR (Hodgkin et al., 2009). The ATS encourages for patients without COPD inclusion in PR programs based on pathophysiology and clinical judgment (Spruit et al., 2013). Patients with idiopathic pulmonary fibrosis (IPF), CF, bronchiectasis, lung transplantation, lung cancer, lung volume reduction surgery, and asthma can be included in PR programs too. The next section will review research studies which have examined the advantages of PR use to manage chronic respiratory conditions other than COPD.

**Interstitial lung disease (ILD).** These are a group of chronic respiratory conditions that includes IPF, connective tissue diseases, acute and chronic interstitial pneumonia and sarcoidosis (Dowman, Hill, & Holland, 2014). Patients with ILD suffer from multiple symptoms such as decreased quality of life and exercise intolerance, and these symptoms are often associated with dyspnea (J. A. Chang, Curtis, Patrick, & Raghu, 1999). Exercise limitations affect patients' respiratory mechanics, gas exchange, and circulation. Exercise training within PR programs is believed to be one of the effective strategies to improve exercise capacity for patients with IPF.

Recent studies suggest that comprehensive PR programs that include exercise components and educational components may be beneficial for patients with ILD. In a Cochrane systematic review, Dowman, L., Hill, C. J., & Holland, A. E. (2014) found that improvements in functional capacity, dyspnea, and HRQoL were demonstrated in ILD following PR. Findings by Ryerson et al. (2014) also concluded that PR improved functional capacity and HRQoL in ILD. Patients with IPF who participated in a study involving a comprehensive PR program had clinically important improvements in the symptom domain measured by the St. George respiratory questionnaire for IPF (SGRQ-I) and reported significant greater physical activities compared to those in the control group (Gaunaurd et al., 2014). Additionally, other studies have associated comprehensive PR with remarkable progress functioning of the lung, functional status, and HRQoL. However, data did not show a significant difference on participants' 6-min-walk-distance (6MWD) before and after PR (Huppmann et al., 2013). Moreover, Swigris, J. J., Fairclough, D. L., Morrison, M., Make, B., Kozora, E., Brown, K. K., & Wamboldt, F. S. (2011) concluded that PR improved functional capacity and fatigue level in patients with IPF. However, the 6MWD was compared to a group of 56 patients with COPD from another study and showed no significant improvement difference. Home-based PR was also associated with improved exercise capacity and HRQoL in patients with IPF. No change was observed in pulmonary function after the home-based PR program among the participants in this study (Ozalevli, Karaali, Ilgin, & Ucan, 2010).

Few other studies in the literature explored the outcomes of the exercise training only for patients with IPF. In a randomized control trial, Vainshelboim, B., Oliveira, J., Yehoshua, L., Weiss, I., Fox, B. D., Fruchter, O., & Kramer, M. R. (2014) concluded that exercise training done under supervision improved dyspnea, exercise tolerance, leg strength, functional capacity, pulmonary functions, and HRQoL in patients with IPF. Exercise training for upper and lower limbs combined with endurance and strengthening training improved functional exercise capacity, HRQoL, and dyspnea for patients with IPF (A. E. Holland, Hill, Conron, Munro, & McDonald, 2008; Jastrzebski, Gumola, Gawlik, & Kozielski, 2006; Rammaert, Leroy, Cavestri, Wallaert, & Grosbois, 2009).

Pulmonary functions among the exercise-training group demonstrated no difference (Rammaert et al., 2009).

**Cystic fibrosis (CF).** CF is defined as a chronic disorder that affects the functioning of the exocrine glands and causes thick mucus to be formed in the airways. The accumulation of secretions in the lungs' airways increases the dead space area that is not involved in ventilation. Thus, patients with CF suffer from deteriorations in lung functions and exercise capacity (Orenstein & Higgins, 2005). Regular exercises are essential in treatment plans for patients with CF to overcome the disease presentations (Spruit et al., 2013). Before 2013, the rehabilitation literature lacks high-quality clinical trials that explored the benefits of providing comprehensive rehabilitation services for patients with CF (Spruit et al., 2013). Few studies then emerged that investigated the role of different exercise trainings for patients with CF.

In a Cochrane systematic review published in 2015, Radtke, T., Nolan, S. J., Hebestreit, H., & Kriemler, S. (2015) concluded that there is limited evidence supporting physical exercise training having a positive effect on exercise capacity, pulmonary function and HRQoL for patients with CF. However, this review's interpretation should be cautious. Studies that were reviewed for this article were heterogeneous with regards to training modalities and durations. Most of the reviewed studies had methodological limitations, and incomplete reporting of data.

Participating in a comprehensive PR program that includes physical activities, supervised breathing exercise, and chest physiotherapy can improve physiologic outcomes and HRQoL for patients with CF. Data from Moeller, A., Stämpfli, S. F., Rueckert, B., Rechsteiner, T., Hamacher, J., & Wildhaber, J. H. (2010) and Schmitz, T. G., & Goldbeck, L. (2006) have shown significant improvements in inspiratory and forced vital capacity for patients with CF after PR. Findings from Schmitz and Goldbeck (2006) concluded that PR could improve clinical symptoms and lung functions for patients with CF. However, no significant improvements were found in airflow obstruction or airway inflammation as measured by sputum and exhaled breath condensates.

Exercise-based rehabilitation programs have the potential to improve physical fitness outcomes of patients with CF (Burtin & Hebestreit, 2015). Franco, C. B., Ribeiro, A. F., Morcillo, A. M., Zambon, M. P., Almeida, M. B., & Rozov, T. (2014) found that Pilates mat exercise significantly improved the respiratory muscle strength in patients with CF. However, the results of the pulmonary function tests (PFT) of the participants did not change significantly post intervention. Active cycle of breathing techniques with exercise training increased thoracic mobility and physical fitness for patients with CF (Elbasan, Tunali, Duzgun, & Ozcelik, 2012). Selvadurai, H. C., Blimkie, C. J., Meyers, N., Mellis, C. M., Cooper, P. J., & Van Asperen, P. P. (2002) found that aerobic training (treadmill or stationary bike) can significantly improve children's activity levels, peak aerobic capacity, and quality of life. The study concluded that children with CF who received either aerobic or resistance training had better outcomes in relation to children in the control group with no exercise training.

**Bronchiectasis.** Bronchiectasis is characterized by excessive sputum production and cough with physical fatigue and reduced exercise tolerance. Exercise intolerance is caused by dyspnea, abnormal respiratory mechanics, and dynamic hyperinflation (Lee et al., 2009). The goal of PR for patients with bronchiectasis is to improve their exercise capacity and improve their quality of life.

The literature review revealed only one study that explored the effect of comprehensive PR in patients with bronchiectasis. Comprehensive PR that includes treadmill sessions, strengthening exercises and education about self-management had significant effects on 6MWD and chronic respiratory disease questionnaire (CRQ) for bronchiectasis patients (Ong, Lee, Hill, Holland, & Denehy, 2011). Two other studies examined the effects of an exercise-based PR program for patients with bronchiectasis. Exercise training can improve the physical fitness of patients with bronchiectasis (Burtin & Hebestreit, 2015). Newall, C., Stockley, R. A., & Hill, S. L. (2005) found that patients with bronchiectasis who performed either targeted or sham inspiratory muscle training (IMT) demonstrated significant increases in the incremental shuttle walking test (ISWT), endurance exercise capacity, and inspiratory muscle strength compared with the control group. Sham IMT defined in this study as "using the same type of IMT device at an intensity of $\leq$ 8.30 cm $H_2O$ for normocapnic individuals or $\leq$ 11.50 cm $H_2O$ for individuals with moderate hypercapnia." (Geddes, O'Brien, Reid, Brooks, & Crowe, 2008, p. 1716). Bicycle exercise effects and upper and quadriceps training on pulmonary function and blood gas values were insignificant. However, when the data of a sub group of the participants (patients with idiopathic bronchiectasis) was analyzed, the improvements in pulmonary function values were significant (van Zeller et al., 2012).

**Asthma.** Asthma is usually associated with dyspnea, wheezing, and impaired quality of life (Guerra, 2009). Patients with asthma may avoid physical exercise because of the symptoms, which may explain why patients with asthma are less physically fit than other patients (Mendes et al., 2010). Studies suggest that comprehensive PR including endurance training, breathing exercises and education has positive effects on outcomes and symptoms for patients with asthma. Miyamoto et al. (2014) found significant improvements in dyspnea grade, quadriceps force, and incremental shuttle walk distance (ISWD) in patients with asthma who participated in the PR program. Furthermore, comprehensive PR was associated with improvements in asthma-specific HRQoL in anxiety and depression levels, asthma symptoms, and pulmonary functions for patients with asthma (Bingöl Karakoç et al., 2000; Mendes et al., 2010). Comprehensive PR was correlated with increased walking distance, maximum exercise capacity, and maximum oxygen uptake, dyspnea, and overall HRQoL in asthma patients. Lung functions among the participants did not show significant changes (Bingisser et al., 2001). Cox, N. J., Hendricks, J. C., Binkhorst, R. A., & van Herwaarden, C. L. (1993) found that a PR consisting of exercise and education components significantly improved pulmonary functions, physical condition, muscle functions, and daily activities in patients with asthma. PR was also associated with decreased consumption of medical care and increased number of working days after the program.

**Lung transplantation.** Patients in the pre-phase or post-phase of lung-volume-reduction surgery or lung transplantation present with high degree of ventilator limitations. PR programs aim to prepare the patient physically and emotionally to reduce surgical complications and improve outcomes (Rochester, 2008). PR programs including exercise, breathing techniques, and self-management education could improve patients' outcomes after lung transplantation.

The effects of comprehensive PR programs that include endurance training, breathing exercises, and education were explored in many studies that included patients waiting for lung transplantation. PR improved significantly and clinically the exercise capacity and HRQoL in patients awaiting lung transplantation (Florian et al., 2013; Gloeckl, Halle, & Kenn, 2012; Kenn et al., 2015). The other group of studies examines the effects of comprehensive PR programs that consisted of exercise training, breathing exercises, aerobic sessions with breathing exercises, and self-management educational sessions in patients following lung transplantation. Ihle et al. (2011) found statistically significant improvement in exercise capacity measured by the 6MWD test. No statistically significant improvement was measured in HRQoL among the participants. Data from Munro, P. E., Holland, A. E., Bailey, M., Button, B. M., & Snell, G. I. (2009) demonstrated that lung functions, functional exercise capacity, and HRQoL of the participants in the PR program following lung transplantation showed statistical improvements. Significant improvement in 6MWD was seen only over the two-month study period.

Few studies examined the effects of exercise-based PR that include walking, aerobic exercises, and resistance exercises for patients referred for lung transplantation. Jastrzebski, D., Gumola, A., Gawlik, R., & Kozielski, J. (2013), in a prospective study, found that walking resulted in significant improvements in exercise capacity and forced vital capacity (FVC) for patients referred for lung transplantation. Findings from Li, M., Mathur, S., Chowdhury, N. A., Helm, D., & Singer, L. G. (2013) also showed significant increases in exercise training capacity and HRQoL from the start of the training program until the transplantation surgery. The data showed decreased in the 6MWD for the study participants compared to the baseline.

Exercise-based PR was associated with clinical and psychological benefits in patients following lung transplantation. In a randomized control trial, Langer et al. (2012) found that minutes of daily walking time, quality of life, cardiovascular morbidity and physical fitness in lung recipients for exercise training program participants showed significant improvements. Furthermore, Vivodtzev et al. (2011) concluded that training programs for patients after lung transplantation significantly improved endurance time, muscle strength, and dyspnea score. The data showed no significant changes in pulmonary functions and HRQoL scores except for dyspnea score. Treadmill walking and quadriceps muscle training for patients after lung transplantation improved lung functions and 6MWD compared with pre PR. Also, 6MWD and muscle force recovered to the pre-transplant values after the PR (Maury et al., 2008). Wickerson, L., Mathur, S., & Brooks, D. (2010) concluded that despite the improvements reported in some of the studies included in their review, exercise did not improve exercise capacity and muscle strength to the predicted level among patients who attended PR after lung transplantation.

**Barriers to Attend PR Programs**

Adherence is a complex, multidimensional behavior that could affect the management of chronic diseases (Nici, 2012). The WHO defines adherence as “how close a person’s behavior which in this case means taking medication, sticking to a diet, and executing lifestyle changes, is matching with the recommended form by health care providers." (Sabaté, 2003, p. 3). Even though benefits associated with PR are well known, some of the patients who were referred to a program never attended one, and some of them attended but did not complete the program (Keating et al., 2011). Patients' adherence to PR programs is critical to achieving the goals in managing disease symptoms. Poor adherence could result in high morbidity rates, high health care costs, more frequent hospitalizations, and as a result that would affect the quality of life (Scullion, 2010). Adherence to PR programs for patients with chronic diseases is expected to be low because of the disease's symptoms, including dyspnea and muscle weakness (Fernández et al., 2009).

Some patients are hesitant when they are referred to PR programs, and a proportion of the referred patients decline participation. Young, P., Dewse, M., Fergusson, W., & Kolbe, J. (1999) found that 34% of the initial 88 COPD patients who were referred for PR declined participation, and of the 55 patients who participated in the program, 36% were considered to be non-adherent. In Young et al. study, the main reasons for non-participation reported by the participants were being widowed or divorced, living alone, living in rented accommodations, and being a current smoker. Transportation difficulties, the patient considering him or herself to be too ill to participate, and the patient considering the program to be unhelpful were also reported as reasons for non-adherence (Young et al., 1999). In a qualitative study, Arnold, E., Bruton, A., & Ellis-Hill, C. (2006) concluded that adherence was associated with two variables: the referrer recommendation and patient's perception of the PR benefits. The non-adherence group mentioned that they had received a negative impression from the medical referrer, and they lacked the social support and the motivation to attend the program.

Keating et al. (2011) found that one of the factors for non-attendance in PR programs was the personal perception of the program. Patients who declined attendance to PR programs thought that the program was not beneficial, the program disturbed their daily routine, the program conflicted with their time, or they received negative influences from their health care providers. In Keating et al.'s study, non-completion of PR was associated with illness complications, deteriorations in psychological status, and failure to quit smoking. Accessing the PR program also played a role in the adherence for patients with movement disabilities or financial limits. A summary of the reasons for non-participation or non-adherence in PR programs can be found in Table 1.

Table 1

*Reasons for Non-participation or Non-adherence in PR Programs*

| Reasons for non-participation | Reasons for non-adherence |
|---|---|
| • Being widowed or divorced.<br>• Living alone.<br>• Living in rented accommodations.<br>• Being currently smokers.<br>• Receiving personal perception about the program. | • Transportation difficulties.<br>• Patient considering him or herself to be too ill to participate.<br>• Patient considering the program to be unhelpful.<br>• Lacking the social support and the motivation.<br>• Receiving negative impressions from the medical referrer.<br>• Illness complications.<br>• Deteriorations in the psychological status.<br>• Failure to quit smoking.<br>• Poor accessing to the program.<br>• Moving disabilities.<br>• Financial limits. |

## Improving Patients' Attendance to PR Programs

In order to improve patients' participation and adherence to PR programs, tools like distance supervision devices and telehealth systems have been introduced. Remote supervision can improve independent rehabilitation at home programs through the minimization of anxiety in patients and health care providers sides and by the provision of accurate prescriptions of exercise (Tang et al., 2012).

## Telehealth

Telehealth is also be described as "the enhancement of health and social care delivery remotely to patients at home through telecommunications and computer-based systems." (Brownsell, Blackburn, Aldred, & Porteus, 2006). In the last two decades, telehealth has been used in many health-related disciplines. In the next section, the uses of telehealth to provide health care services for patients with respiratory conditions will be reviewed.

## Telehealth for Patients with Chronic Respiratory Diseases

**Telehealth for patients with COPD.** Telehealth is one of the options used to monitor and manage patients with COPD in their homes. Telehealth provides the health care team with accurate clinical information about their patients, which enables them to provide efficient home care for patients (Marshall, 2009). Telehealth could potentially serve as an effective model of care for patients with COPD, and as a way to promote independence. Using telehealth can be utilized as a method to monitor patients at home, give a sense of continuity of care, and support patients' self-management. Telehealth could also be used for acute care by using interactive video conferencing to provide instance instructions and feedback. However, the use of telehealth for patients with COPD needs further study to determine whether the use of telecommunication technology could decrease the need for on-site visits and enhance patient care. To date, only few studies have been conducted to establish the efficacy of telehealth in patients with COPD.

Recent studies indicated that telehealth was a feasible and accepted modality to monitor patients with COPD at home (Tabak, Brusse-Keizer, van der Valk, Hermens, & Vollenbroek-Hutten, 2014). The telehealth program in Tabak et al.'s study ran for nine months and consisted of real-time coaching of daily activity, web-based exercise program, self-management of COPD, and teleconsultation. Another study conducted by Shany, T., Hession, M., Pryce, D., Galang, R., Roberts, M., Lovell, N., & Basilakis, J. (2010) also showed high acceptance for telehealth in patients with COPD, and low acceptance among clinicians. Using telehealth to monitor patients with COPD at home was considered as a good method to reassure patients, give a sense of continuity of care, and support patients' self-management behaviors (Williams, Price, Hardinge, Tarassenko, & Farmer, 2014).

Telehealth holds many potential clinical and social benefits for patients with COPD. Lundell, Holmner, Rehn, Nyberg, & Wadell (2014) conducted a systematic review to explore the effects of using telehealth on physical activity level, physical capacity, and dyspnea for patients with COPD. Findings of this review showed that using telehealth in patients with COPD was associated with positive effects on physical activity. Also, the study conducted by Shany, T., Hession, M., Pryce, D., Galang, R., Roberts, M., Lovell, N., & Basilakis, J. (2010) showed average improvements of eight units in symptoms, impact, and activity categories of the St. George's Respiratory Questionnaire (SGRQ) in the telehealth group, and no improvement in the quality of life category. Data from Shany et al.'s study showed no significant improvements among the participants in anxiety or depression scores.

Telehealth could reduce the number of emergency department visits and the number of hospitalization days in patients with COPD. In terms of deaths, data showed no effect on the odds ratio of mortality between patients with COPD in the intervention and the control group (McLean et al., 2012; Polisena et al., 2010; Shany et al., 2010; Vontetsianos et al., 2005). Using telehealth was reported as being a safe and useful modality to detect and manage exacerbations in early stages by detecting abnormalities in patient's vital signs and spirometry parameters (Segrelles Calvo et al., 2014).

**Telehealth for patients with asthma.** A review to identify studies that examined telehealth for patients with asthma was conducted on journal publications PubMed, MEDLINE, CINAHL, and Health Source. The key words used for the search were *pulmonary, respiratory, asthma*, and *lung* in conjunction with each of the following terms: *telehealth, telemonitoring,* and *telehomecare*. After eliminating unrelated articles based on the inclusion and exclusion criteria, only seven articles were eligible for inclusion in this review.

Table 2 summarizes the seven studies that explored the use of telehealth to monitor and manage patients with asthma. Many of these studies focused on the use of telehealth to manage and control asthma symptoms (Chan et al., 2007; Guendelman, Meade, Benson, Chen, & Samuels, 2002; Jan et al., 2007; Rasmussen, Phanareth, Nolte, & Backer, 2005). The results of these studies showed that the use of telehealth improved clinical outcomes of patients with asthma when compared with outcomes from conventional clinical asthma management. Two other studies investigated the feasibility of telehealth using a portable spirometer (Steel et al., 2002; Willems et al., 2007). Willems, D. C. M., Joore, M. A., Hendriks, J. J. E., van Duurling, R. A. H., Wouters, E. F. M., & Severens, J. L. Y. (2007) concluded that some technical and logistical issues needed to be solved in order to apply the telehealth nurse-led self-management intervention. Steel, S., Lock, S., Johnson, N., Martinez, Y., Marquilles, E., & Bayford, R. (2002) concluded that the electronic remote monitoring of patients with asthma at home was feasible, and the use of the telehealth equipment was acceptable and helpful. Only one study in this review investigated the capability of patients to perform valid spirometry self-testing at home (J. Finkelstein, Cabrera, & Hripcsak, 2000). Statistical analysis in J. Finkelstein et al.'s study showed that data entries obtained by patient self-testing showed no statistically significant difference when compared with data obtained under supervised measuring.

Table 2
*Description of Telehealth Studies Involved Patients With Asthma*

| Source | Country | Mean Patient Age, | Study Duration | Group Size | Control Group |
|---|---|---|---|---|---|
| Willems et al. 2007 | Netherlands | Adults (64), Children (11) | 12 months | 55 | _ |
| Chan et al. 2007 | USA | 12 | 12 months | 60 | 60 |
| Linda et al. 2005 | Denmark | 29 | 6 months | 88 | 80 |
| Steel et al. 2002 | Spain, UK | 34 | 2 weeks | 33 | _ |
| Jan et al. 2007 | Taiwan | 10 | 12 weeks | 88 | 76 |
| Guendelman et al. 2002 | USA | 12 | 90 days | 66 | 68 |
| Finkelstein et al. 2000 | USA | 41.9 ± 12.8 | 3 weeks | 31 | _ |

This review included seven studies that used telehealth to manage asthma at home. Four studies from the seven used control groups (Chan et al., 2007; Guendelman et al., 2002; Jan et al., 2007; Rasmussen et al., 2005), which provided stronger evidence for the results in these studies. The sample size in these studies remained problematic, due to the fact that most of the studies were limited to small samples. These telehealth studies used different measurement technologies (See Table 3). These methods are valid and reliable to measure patients' respiratory conditions. Three of the studies used a standard telephone line to transfer the measured data (Guendelman et al., 2002; Steel et al., 2002; Willems et al., 2007). Many of the studies used Internet connections and personal computers or laptops to transfer the data (Chan et al., 2007; Jan et al., 2007; Rasmussen et al., 2005). Only one study used a digital video camera to evaluate patients (J. Finkelstein et al., 2000). No detailed cost analysis was performed in the reviewed studies to estimate the actual savings associated with the use of telehealth. However, to advocate the use of telehealth as a patient-management approach and to incorporate it into practice, practitioners must have evidence indicating its economic benefits and cost effectiveness.

Table 3
*Different Technologies Used in Telehealth Studies for Asthmatic Patients*

| Source | Technology Used |
|---|---|
| Willems et al. 2007 | Electronic spirometer, personal digital assistant, standard telephone line. |
| Chan et al. 2007 | Peak flow meter, computer system, digital video camera, Internet access. |
| Linda et al. 2005 | Electronic diary, peak flow meter, computer or push-button telephone. |
| Steel et al. 2002 | Asthma monitor, modem, telephone line. |
| Jan et al. 2007 | Electronic peak flow meter, electronic diary, computer, Internet connection. |
| Guendelman et al. 2002 | Monitoring device (Health Buddy), telephone line. |
| Finkelstein et al. 2000 | Portable spirometer, palmtop computer, telephone or wireless network. |

**Telehealth for patients with CF.** The use of telehealth as a support mechanism for care and for communication between the specialist hospitals and the patients' caregivers at home is feasible. In fact, telehealth could be used to enhance high-quality medical support for patients in their home environment as demonstrated by the telehealth studies for CF. Cox, N. S., Alison, J. A., Rasekaba, T., & Holland, A. E. (2012) found insufficient evidence to support a firm conclusion about telehealth's benefits amongst CF patients. In general, the reviews included were small with limited generalizability. Based on these studies, participants were willing to use telehealth, and they had no concerns about their clinical data being transferred through the telehealth system. Only one study in this review had used telehealth to provide an intervention (pulmonary consultation) to patients at home and observed a cost saving on telehealth sessions compared to the on-site visits. Another study showed that remote assessment of exercise tolerance using telehealth is appropriate for patients with CF (N. S. Cox, Alison, Button, Wilson, & Holland, 2013). The study conducted by Cox and colleagues showed that the 3-minute step test performed via telehealth was similar to the results from the exercise sessions performed in the clinic under supervision. Participants' comfort ratings were not different between the two settings of exercise sessions (N. S. Cox et al., 2013).

Telehealth could be used to detect early changes and help in early diagnosis of abnormalities of lung functions for patients with CF. Using telehealth could minimize patients' complications during the early phase of care after lung transplantation. Even though telehealth did not influence adherence to spirometry or reduce the frequency of consultations, the telehealth group demonstrated a lower level of anxiety and depression (Sengpiel et al., 2010). After six months of using telehealth, Wilkinson, O. M., Duncan-Skingle, F., Pryor, J. A., & Hodson, M. E. (2008) found no differences in quality of life, anxiety or depression, admission to hospital, or clinic attendance in patients with CF. A significant improvement in acceptance of the disease and its prognosis were observed in the telehealth group.

**Telerehabilitation**

Telerehabilitation is "an emerging technology that facilitates the deliverance of rehabilitation services at a distance by combining telecommunication and electronic transmission of health information." (Tang et al., 2012, p. 2). The interest in using telehealth for rehabilitation is rapidly growing. In an electronic search using databases such as the CINAHL, Ovid MEDLINE, and PubMed databases with the term *telerehabilitation* produced respectively 269,539, and 547 results. Not all the results fully represent clinical studies that used telehealth in the rehabilitation field or have used the Internet as a way to provide rehabilitation services for patients at home. Several systematic reviews and clinical trials that used telerehabilitation for patients with conditions other than respiratory diseases will be reviewed in this section.

**Telerehabilitation for Patients with Non-Respiratory Diseases**

Telerehabilitation can be used in different medical specialties. The application of telerehabilitation technologies can be seen in physical therapy, neuropsychology, cardiac and pulmonary rehabilitation, and for patients with stroke. The first review on the topic of telerehabilitation was conducted by Rogante, M., Grigioni, M., Cordella, D., & Giacomozzi, C. (2010). The Rogante et al.'s review covered the entire set of telerehabilitation articles from the time of the first article published on the topic in 1998 to 2008. The included articles in their review investigated several pathologies and medical cases such as joint replacement, stroke, walking inability, ulcers and wounds, Parkinson's disease, cerebral palsy, and digestive diseases. Findings suggest that the literature lacks comprehensive studies that can provide strong evidence to support decision making and policy makers regarding the use of telerehabilitation in the future (Rogante, Grigioni, Cordella, & Giacomozzi, 2010). In another review, Dos Santos et al. (2014) searched for all the randomized control trials that used telerehabilitation for children and adolescents from 2002 to 2012. Telerehabilitation was found to have the potential to produce positive outcomes when compared to alternative options. Telerehabilitation resulted in a decreased occurrence of symptoms, improvements in

HRQoL, greater adherence to the treatment plans, and better practice of physical exercises.

A recent study reviewed telerehabilitation in stroke patients (Chen et al., 2015). Telerehabilitation was not superior to traditional rehabilitation in improving the ability of patients with stroke to perform daily activities nor were motor functions improved. Telerehabilitation was associated with improvements in the HRQoL and reducing expenses related to rehabilitation after a stroke. Linder, S. M., Rosenfeldt, A. B., Bay, R. C., Sahu, K., Wolf, S. L., & Alberts, J. L. (2015) found a significant increase in the HRQoL in stroke patients using a robotic-assisted telerehabilitation program.

Recently, other reviews focused on using telerehabilitation for certain conditions such as cardiopulmonary diseases, stroke, or physical disabilities. Frederix, I., Vanhees, L., Dendale, P., & Goetschalckx, K. (2015)'s systematic review concluded that telerehabilitation was feasible and effective as an additional or alternative method of rehabilitation compared with conventional methods. Hwang, R., Bruning, J., Morris, N., Mandrusiak, A., & Russell, T. (2015) concluded that telerehabilitation increased exercise capability and HRQoL in cardiopulmonary diseases. Even though the benefits from telerehabilitation were not different compared with center-based programs, participants in the telerehabilitation programs had higher adherence rates compared with center-based programs.

Few studies examined the effects of using telerehabilitation to provide physical training and support for different categories of medical conditions at home. Kairy, Lehoux, Vincent, & Visintin (2009) found that the clinical outcomes of telerehabilitation improved, or at least were similar or better when compared to an alternative method of care. Users' satisfaction was reported in the included articles as being high. Furthermore, Levy, C. E., Silverman, E., Huanguang, J., Geiss, M., & Omura, D. (2015) found that using telerehabilitation significantly improved physical function, cognitive function, functional independence, and HRQoL among the participants. Telerehabilitation was also found to be beneficial in reducing the time, cost, and inconvenience associated with receiving rehabilitation. Participants in this program had different diagnoses such as debility, balance and mobility impairments, neurological diagnosis, shoulder pain, mechanical low back pain or knee pain. Moreover, data from another study showed that functional status of the participants was significantly improved after the telerehabilitation. Telerehabilitation participants reported a high level of support while using the physical telerehabilitation program (Joseph Finkelstein, Wood, & Cha, 2012).

**Telerehabilitation for Patients with COPD: A Systematic Review**

The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) acknowledges the benefits and added value the use of telehealth technology might add in advancing the delivery of cardiac and pulmonary rehabilitation services. Telehealth technology could be used as an adjunct to an existing therapeutic modality, a method to improve the time frame of therapeutic contact, or as an alternative tool when access to care is not available (Shaw, Heggestad-Hereford, Southard, & Sparks, 2001).

The aim of this review was to provide a narrative synthesis of the literature of research studies, which used telehealth mediums with video components to provide real-time PR services for patients with COPD at home. This review will provide a summary of the benefits of using telehealth in delivering PR services for patients with COPD at home. The review will also describe the PR services that have been provided via the Internet, and what types of telehealth technology have been used in the included studies.

**Literature review methods.** An extensive systematic search of the literature with multiple search strategies was completed using an electronic databases search in the Ovid MEDLINE, CINAHL, and PubMed databases. The specific search terms used were: *pulmonary rehabilitation* and *COPD* in conjunction with each of the following terms: *telehealth*, *telemedicine*, *telecare*, *telehomecare*, *videoconferencing*, *Ehealth*, and *real-time telerehabilitation*. For the purpose of this review, the inclusion criteria were: a) English-language publications, b) research studies that involved patients with COPD, and c) research studies that used telehealth technology with a video component to provide home-based real-time pulmonary rehabilitation services. Research studies that examined store and forward telemonitoring technology or used simple communication technologies such as phone calls and emails to follow up with patients or to transfer patients' data will be excluded from the review. This review focuses on real-time telehealth because it is the appropriate type of telehealth based on the nature of the field of pulmonary rehabilitation, which needs real-time interactions with patients.

**Findings.** The electronic searches resulted in over than 1,000 articles. Based on titles screening, only 81 articles have met the inclusion criteria. Then, full text copies of the 81 articles have been reviewed, and only eight studies met the inclusion criteria based on the studies' descriptions. One of the final eight studies was excluded because it includes insufficient information about the method of delivering pulmonary rehabilitation services for the participants in the study. Each study was graded for the level of evidence based on the hierarchy developed by Melnyk and Fineout-Overholt (Melnyk & Fineout-Overholt, 2005). For more detailed information about the rating system, see Table 4. Of the reviewed studies, two studies were scored as evidence level II (Nield & Hoo, 2012; Tabak et al., 2014), one study was scored as evidence level III (Paneroni et al., 2014), and four studies were scored as evidence level IV (Burkow et al., 2013; Anne E. Holland et al., 2013; Tousignant et al., 2012; Zanaboni, Lien, Hjalmarsen, & Wootton, 2013).

Table 4
*Rating System for Hierarchy of Evidence*

| Level | Description |
|---|---|
| I | Evidence from a systematic review or meta-analysis of all relevant RCTs or evidence-based clinical practice guidelines based on systematic reviews of RCTs |
| II | Evidence from at least 1 well-designed RCT |
| III | Evidence from well-designed controlled trials without randomization |
| IV | Evidence from well-designed case-control and cohort studies |
| V | Evidence from systematic reviews of descriptive and qualitative studies |
| VI | Evidence from a single descriptive or qualitative study |
| VII | Evidence from the opinion of authorities and/or reports or expert committees |

This review included seven studies that explored the use of telehealth (Internet and computers) to provide real-time and home-based pulmonary rehabilitation for patients with COPD at home. Table 5 provides summary of purposes, sample size, variables, provided services, and findings for each of the seven studies. Four of the included studies investigated delivering comprehensive pulmonary rehabilitation services—including cardiopulmonary exercise, breathing techniques, and disease-related education (Burkow et al., 2013; Anne E. Holland et al., 2013; Paneroni et al., 2014; Zanaboni et al., 2013). The other three studies investigated the effects of delivering only one or two pulmonary rehabilitation services for COPD patients at home (Nield & Hoo, 2012; Tousignant et al., 2012; Zhao, Zhai, Zhu, & Sun, 2014). The seven studies explored different aspects of using telerehabilitation that include: feasibility, acceptance, safety, and clinical and social benefits.

***Feasibility of using telehealth in pulmonary rehabilitation.*** Findings from six studies concluded that telerehabilitation was a feasible and successful way to conduct real-time PR sessions for COPD patients in their home settings (Anne E. Holland et al., 2013; Nield & Hoo, 2012; Paneroni et al., 2014; Tabak et al., 2014; Tousignant et al., 2012; Zanaboni et al., 2013). Feasibility of the proposed systems was assessed by either counting the number of sessions attended or the programs' completion rates by the participants.

***Acceptance of using telehealth in pulmonary rehabilitation.*** Five studies reported that patients with COPD accepted the use of telerehabilitation to receive PR services at home (Burkow et al., 2013; Anne E. Holland et al., 2013; Paneroni et al., 2014; Tabak et al., 2014; Zanaboni et al., 2013). Patients' acceptance was measured by using the System Usability Scale, which is used widely to document users' experiences of technology (Holland et al., 2013), the Clinical Satisfaction Questionnaire (Tabak et al., 2014), or by conducting interviews (Zanaboni et al., 2013). Two studies reported that computer skills and previous Internet experience of the participants did not affect their level of accepting telerehabilitation programs (Burkow et al., 2013; Nield & Hoo, 2012).

***Safety of using telehealth in pulmonary rehabilitation.*** Two studies evaluated the safety of exercise sessions for patients with COPD at home that were supervised by telerehabilitation (Anne E. Holland et al., 2013; Paneroni et al., 2014). Both studies concluded that using telerehabilitation was safe with no major or moderate adverse events.

***Benefits of using telehealth in pulmonary rehabilitation for patients with COPD.*** *Exercise capacity.* Three studies evaluated functional exercise capacity for patients with COPD attended telerehabilitation programs (Anne E. Holland et al., 2013; Paneroni et al., 2014; Tousignant et al., 2012). In two studies the exercise capacity of the participants improved, but not to the extent to be clinically significant (Anne E. Holland et al., 2013; Tousignant et al., 2012). Results from Paneroni et al. (2014) study showed a significant gain in walking capacity of the participants of the telerehabilitation program.

*Dyspnea.* Three studies measured the effect of using telerehabilitation in dyspnea among patients with COPD (Anne E. Holland et al., 2013; Nield & Hoo, 2012; Paneroni et al., 2014). All the three studies reported that dyspnea intensity was decreased among participants, but was not statistically significant.

*Health-related quality of life.* Health-related quality of life was measured in three studies (Anne E. Holland et al., 2013; Paneroni et al., 2014; Tousignant et al., 2012). Participants in the telerehabilitation programs showed clinically significant improvements in two of the four dimensions of quality of life (dyspnea and fatigue) on the Chronic Respiratory Questionnaire (Anne E. Holland et al., 2013). Tousignant, M., Marquis, N., Pagé, C., Imukuze, N., Métivier, A., St-Onge, V., & Tremblay, A. (2012) reported that all the participants showed a trend toward better quality of life based on the Chronic Respiratory Questionnaire. In Paneroni et al (2014) study, quality of life improved in both the intervention and the control group of 4 points above the mean minimal detectable clinical changes improvement on the St. George's Respiratory Questionnaire.

*Social support.* Two studies evaluated the impact of the real-time telerehabilitation on the sense of social support among patients with COPD. Participants' sense of social support increased when receiving regular interactive sessions with a live person interested in their health status or during the in-group exercise sessions (Burkow et al., 2013; Nield & Hoo, 2012).

*Reduce health care utilization.* From their preliminary results, Zanaboni, P., Lien, L. A., Hjalmarsen, A., & Wootton, R. (2013) concluded that using telerehabilitation appears to be promising in reducing the utilization of the health care systems.

***Pulmonary rehabilitation services provided via telehealth.*** Overall, the seven research studies included in this review gave detailed information about how they conducted the telerehabilitation sessions. Four of the telerehabilitation trials provided educational instructions regarding self-management of COPD, and long-term oxygen therapy (Burkow et al., 2013; Paneroni et al., 2014; Tabak et al., 2014; Zanaboni et al., 2013). Educational sessions about performing pursed-lip breathing techniques to relieve dyspnea were provided in two programs (Nield & Hoo, 2012; Tabak et al., 2014). Four programs provided cardiopulmonary exercises for participants using stationary bikes at home (Anne E. Holland et al., 2013; Paneroni et al., 2014; Tousignant et al., 2012; Zanaboni et al., 2013). In addition to the cardiopulmonary training, three trials provided supervised resistance training sessions intended to strengthen upper and lower extremities and to increase thoracic muscle flexibility of COPD patients (Burkow et al., 2013;

Paneroni et al., 2014; Tabak et al., 2014). Tabak, M., Brusse-Keizer, M., van der Valk, P., Hermens, H., & Vollenbroek-Hutten, M. (2014) telerehabilitation program included relaxation, mobilization, andmucus clearance for every individual patient. In this study the physiotherapy in the monitoring center utilized a program called “the Condition Coach” to monitor the patients and provide feedback. The Condition Coach consists of four modules: 1) activity coach for ambulant activity monitoring and real-time coaching, 2) web-based exercise program for home exercising, 3) self-management of COPD exacerbations, and 4) teleconsultation.

***The telehealth technologies used in telerehabilitation.*** All the seven trials used the Internet to connect participants at home to the rehabilitation centers. Four trials used specially developed telerehabilitation interface systems for COPD patients at home, and for health care providers at the rehabilitation centers (Burkow et al., 2013; Paneroni et al., 2014; Tabak et al., 2014; Tousignant et al., 2012). The other three trials used commercially available equipment (personal computers and tablets with built-in webcam), for free video calling software programs (Skype ™ VSee ™, and LifeSize ClearSea) or equipment from an existing PR program such as pulse oximeter devices and ergometers (Anne E. Holland et al., 2013; Nield & Hoo, 2012; Zanaboni et al., 2013).

Table 5
*Summary of Studies Purposes, Technology Used, Samples, Provided Services, and Findings*

| Author (s), date, location | Level of Evidence | Purpose of the Study | Technology | Sample Size | Provided Service | Findings |
|---|---|---|---|---|---|---|
| Burkow, et al. 2013, Norway. | IV | Assess patients' acceptability of an Internet-enabled program for comprehensive pulmonary rehabilitation program. | An Internet-connected system. Interface at home consisted of user's own TV connected to a computer, and the Residential Patient Device. | 5 participants. | Education sessions about COPD and LTOT, group exercising, and individual consultation. | The Internet-enabled program for home-based groups was generally well accepted by the participants. |
| Holland, et al. 2013, Australia. | IV | Evaluate safety and establish the feasibility and acceptability of real-time, home-based pulmonary rehabilitation program. | A cycle ergometer, a pulse oximeter, and a tablet computer, and videoconferencing video collaboration software. | 8 participants. | Cycling exercise training supervised by a physiotherapist and education about self-management of COPD. | A simple model of telerehabilitation using readily available equipment is safe and feasible. |
| Tabak et al. (2014), Netherlands. | II | 1) Explored the satisfaction of the participants' with telerehabilitation2) Explore the clinical measures of telerehabilitation compared to the usual care. | 1) Activity coach application for activity registration and real-time feedback.<br>2) A web portal with a symptom dairy for self-treatment of exacerbations. | 29 participants. (14 participants in the intervention group). | Exercise program, self-management education, and teleconsultation. | Telerehabilitation was feasible and showed high satisfaction among participants. The self-management module was highly used, while the use of the exercise module was low. |

Table 5 Continued

*Summary of Studies Purposes, Technology Used, Samples, Provided Services, and Findings*

| Author (s), date, location | Level of Evidence | Purpose of the Study | Technology | Sample Size | Provided Service | Findings |
|---|---|---|---|---|---|---|
| Nield and Hoo. 2012, USA. | II | Determine the feasibility and efficacy of using real-time interactive telehealth for teaching pursed-lip breathing (PLB) | A laptop computer, headphone, and pulse oximeter. A free web-based software program (Skype). | 22 participants. Nine patients in the intervention group. | One component of a dyspnea self-management program (pursed-lips breathing, PLB) | Real-time interactive voice and video telecommunication is feasible, and can improve social support, access to health care and delivery of education. |
| Tousignant, et al. 2012, Canada. | IV | Investigate the efficacy of in-home pulmonary rehabilitation for people with COPD. | Videoconferencing system, LCD screen, router and modem, and sensors. | 3 participants. | Cardiopulmonary exercises. | Telehealth seems to be a practical way to provide rehabilitation services. |
| Paneroni et al. 2014, Italy. | III | Explore the feasibility, adherence, and satisfaction of a home-based telerehabilitation program. | Interactive TV software, oximeter, steps counter, a bicycle, and remote control to interact with the application. | 18 participants in the intervention group. | Strength exercise, telemonitored cycle training, educational sessions, and video-assistance and phone-calls. | Telerehabilitation was feasible and well accepted. Telerehabilitation improved walking capacity, dyspnea, quality of life and daily physical activity. |
| Zanaboni et al. 2013, Norway. | IV | Investigate the feasibility of a long-term telerehabilitation service. | A treadmill, a pulse oximeter, a tablet computer. | 10 participants. | Exercise training, telemonitoring and education/ self management. | Telerehabilitation was feasible and it could reduce health care utilization. |

**Discussion.** Findings of this review confirmed that providing PR using specially designed or commercially available telecommunication equipment is feasible, accepted, and safe. The results from this review suggest that using telerehabilitation for COPD patients at home was associated with positive clinical outcomes that include improvements in quality of life, exercise capacity, dyspnea level, and the sense of social support.

Several studies in this review suffered from methodological issues including the small sample sizes (e.g., three, five, and up to eighteen participants), the use of weak research designs with no control groups, and bias in recruitment procedures. Tabak et al. (2014) reported that recruiting patients was difficult because of the strict inclusion and exclusion criteria that include the need for a computer with Internet access at home, which is not always possible for elderly patients. In Tabak et al. (2014) study, only two participants (24%) were able to continue the study in the control group, and only nine (66%) patients were able to finish the nine-moth program. In addition, exacerbations data for the control group were lost during follow-up and were not available for analysis. Based on the available data, the telerehabilitation group had four hospitalizations with a median duration of 5.5 days, while the control group had five hospitalizations with a median duration of 7.0 days. Tousignant et al. (2012) reported that patients who agreed to participate in the study were self-motivated and welling to explore new methods of delivering rehabilitation services. The selection bias may cause inflation of the outcomes, and it reduced the possibility to draw a sound conclusion. The System Usability Scale that was utilized in Holland et al.'s study is a 10-item scale that measures users' subjective assessment of effectiveness, efficiency, and satisfaction of systems.

This scale designed to be used after the respondent has had a chance to use the system under evaluation (Brooke, 1996). This type of scales could not be utilized to measure or predict the intention to use new systems among potential users.

**Conclusion.** It is evident from this review that using telerehabilitation for patients with COPD at home has not been investigated sufficiently by researchers. This narrative review highlights, based on the available resources, that using simple and low-cost models of telerehabilitation systems, using available equipment and free videoconferencing software programs, are safe to use and can improve access to PR services, especially for patients living in rural areas. It is worth noting that participants' computer literacy level has no effect on acceptability, or on the utilization of the telerehabilitation systems (Nield & Hoo, 2012). A knowledge gap regarding benefits of using telerehabilitation for COPD patients still exists. Further research with high level of evidence investigating the use of telehealth in PR is needed. There is a critical need to explore telerehabilitation acceptance of all users, including patients and health care practitioners before implementing such programs in the future.

The next section will discuss the determinants of technology acceptance in general, and to identify the theories that have been used to explain behavioral intentions. This discussion will be followed by a systematic review aims to discuss the determinants of telehealth acceptance among potential users, and how the telehealth acceptance determinants have been measured.

**Technology Acceptance**

The next section will discuss the determinants of the technology acceptance and will explore the theories that have been used to explain behavioral intentions in general. This discussion will be followed by a systematic review aimed to discuss the determinants of telehealth acceptance among potential users, and how the telehealth determinants have been measured.

In the past, information-technology developers and health administrators relied on their authority to attract users to their products. However, the authority of health care providers alone is no longer enough to motivate patients to utilize new information-technology systems (Dillon & Morris, 1996). To ensure the successful implementation of telehealth, stakeholders in the health care system are now seeking a deeper understanding of the factors that make telehealth acceptable for both health care practitioners and patients (Kowitlawakul, 2011). Acceptance is “the individual’s psychological state regarding voluntary or intended use of a particular technology.” (P. Y. K. Chau & Hu, 2001, p. 701). Per its definition, acceptance could be the voluntary actual usage or intent towards using a new system. Intention can be defined as the person’s subjective probability of readiness or the likelihood to engage in a certain behavior (Fishbein & Ajzen, 1975). Several models explain users’ intentions, including the theory of planned behavior*,* the theory of reasoned action, health belief model, and diffusion of innovations theory.

**Intention-Based Theories.** There are multiple models that explained users' intentions. In general, the goal of these models is to help identify the variables that might influence intent to utilize a new technology or to adopt new behavior and to help understand their interaction. The models that will be discussed in the next section are theory of reasoned action and theory of planned behavior, the health belief model, technology acceptance model, the unified theory of acceptance and use of technology, as well as diffusion of innovations theory.

***Theory of reasoned action (TRA) and theory of planned behavior (TPB).*** These are concerned with the factors that influence individual motivation and determine the likelihood of an individual to do a certain behavior. Both theories assume that intention toward a certain behavior is the best predictor of future adoption, and intention is a product of two factors: a) attitude and b) social normative perception. TPB is based on TRA and has an additional construct: c) the perception of a capacity to control performance in behavior (Figure 3) (Glanz, Rimer, & Lewis, 2002).

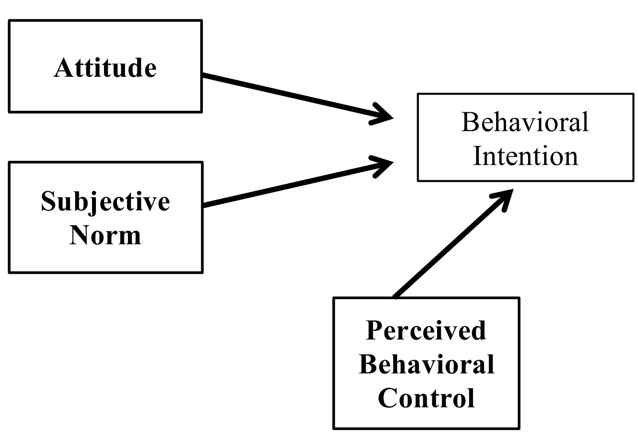


Figure 3. TPB and TRA constructs.

***The health belief model (HBM).*** This is a very commonly used model in the field of health behavior research. HBM was developed to help understand why the rate of participation in detection and prevention programs was low (K. Glanz et al., 2008). According to the HBM, attitude toward or against a health-related behavior is determined by the perceptions of susceptibility, severity, benefits, and barriers. Recently, cues to action, motivating factors and self-efficacy have been added to the HBM (Figure 4) (Hayden, 2009).

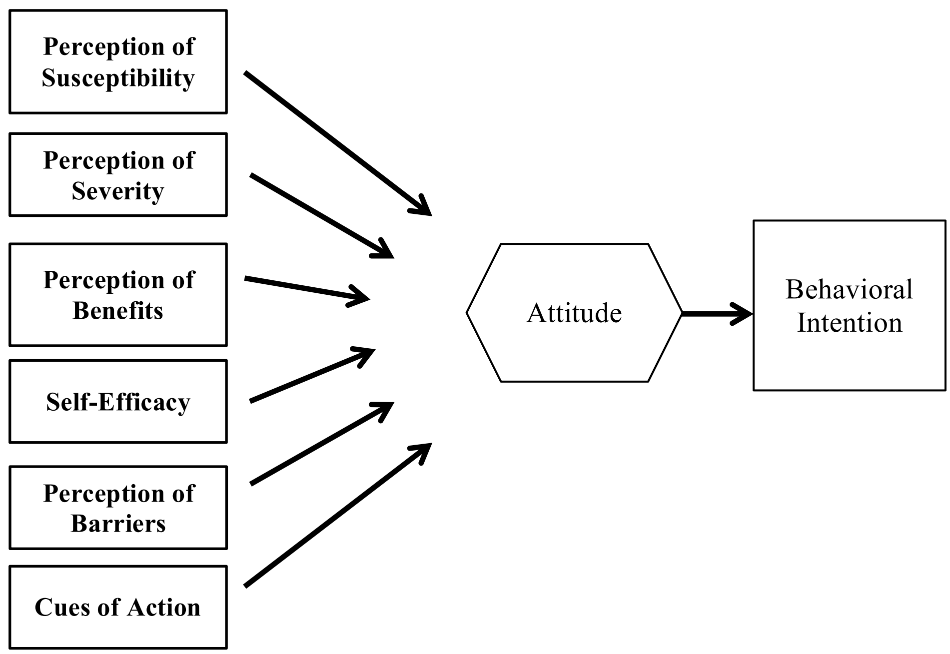

Figure 4. HBM constructs.

***Diffusion of innovations theory (DOI).*** The diffusion of innovation theory is very useful in explaining the adoption processes of innovations by a society or by a group of people. DOI is applicable whether the innovation is a new device or behavior (Hayden, 2009). Based on the DOI theory, the adoption of a new behavior is influenced by the following constructs: relative advantages, compatibility, complexity, trialability, and observability (Figure 5) (Glanz et al., 2002).

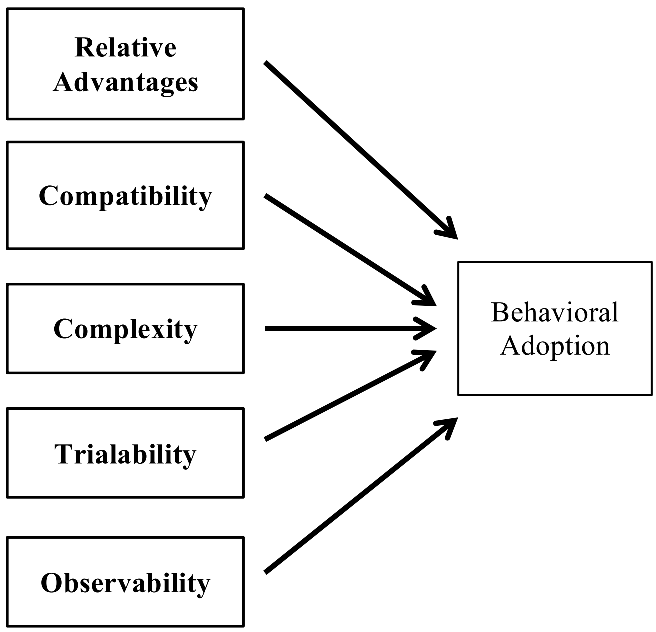


Figure 5. Diffusion of innovation constructs.

***The unified theory of acceptance and use of technology (UTAUT).*** Venkatesh, V., Morris, M., Davis, G., & Davis, F. 2003's UTAUT, formulate a model that can help to explain the individual acceptance of new information technology. The model proposed three key constructs that play a significant and a direct role in intentions to utilize innovations. The constructs are performance expectancy, social influence and effort expectancy (Figure 6).

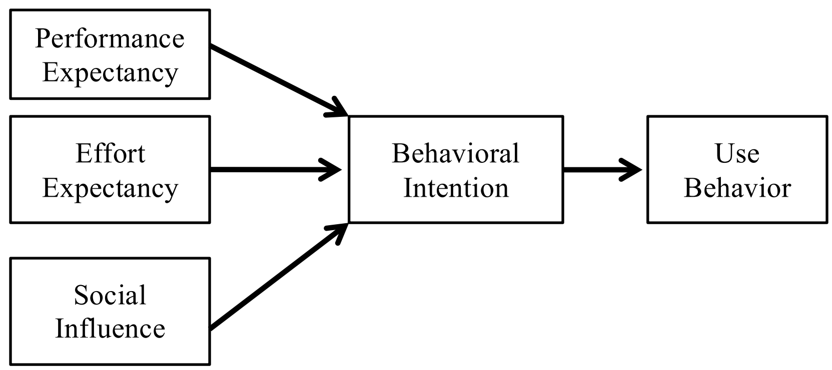


Figure 6. The unified theory of acceptance and use of technology (UTAUT) constructs.

***Technology acceptance model (TAM).*** The TAM is a theoretical model developed by Fred D. Davis in 1985. The model's aim is to help predict users' acceptance of new information technologies, which can help to discover the problems in any new system before implementation. Perceived usefulness (PU) and perceived ease of use (PEOU) are the major determinants of acceptance for the TAM (Fred D. Davis, 1989); see Figure 7 for more details about the TAM constructs.

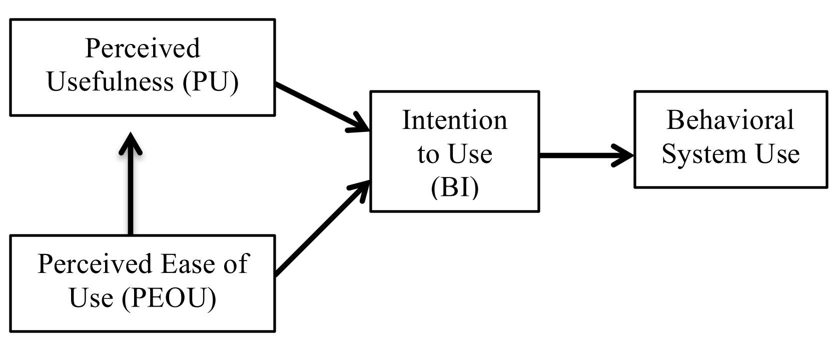


Figure 7. The Technology Acceptance Model (TAM).

Venkatesh and Davis modified TAM by adding the construct of subjective norm and social influence on behavioral intention.  TAM2 suggested that subjective norm has a direct effect on intention (Viswanath Venkatesh & Davis, 2000).  In the modified TAM, the attitude factor was taken out because it did not fully mediate the effects of PU and PEOU on behavioral intention (Figure 8).

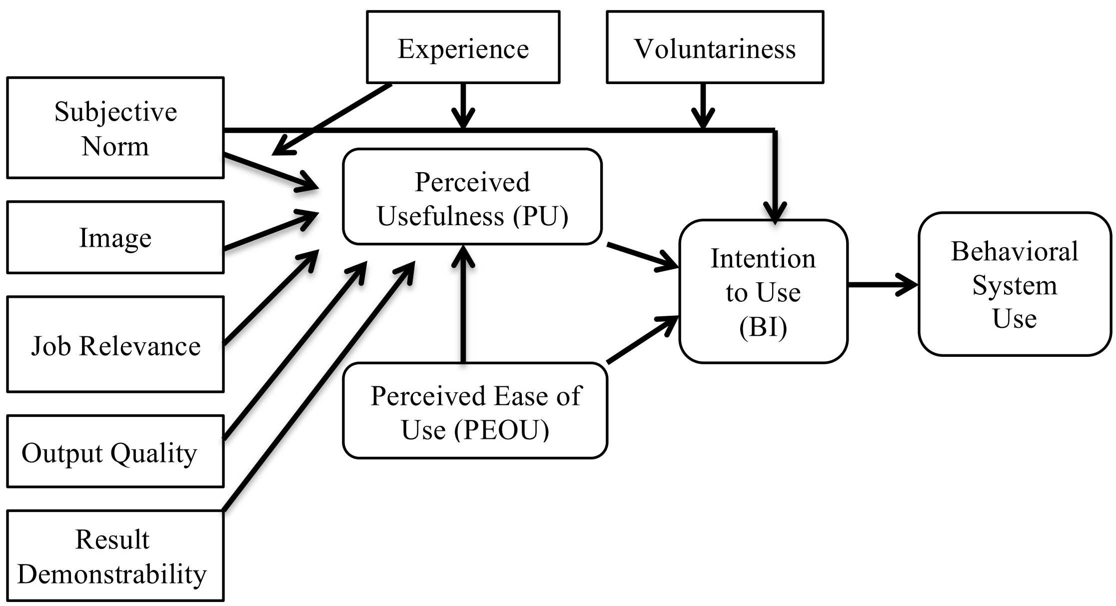


Figure 8. The Modified Technology Acceptance Model (TAM2).

*Constructs of the original TAM.*  Users' decisions to accept a new technology are based on the answers to the following questions: (a) will the new technology help benefit users? And b) will the new technology be hard to use? (Fred D. Davis, 1989).  First, people tend to use new technology systems when they believe that the new technology will help them to perform better.  This can be referred as perceived usefulness (PU). Second, people consider whether the new system is hard to use or not.  Believing that the use of a new technology system is too hard may hinder a person from getting the expected benefits of use. Perceived ease of use (PEOU) is the second factor in influencing future use.

PU is defined in the original TAM as “the extent to which a person trusts that a certain system will improve performance.” (Fred D. Davis, 1989, p. 320). Findings have indicated that health care practitioners feel that using telehealth is useful when it increases their productivity and improves patient care, access to care, documentation, and relationships with patients. Also, using telehealth has been associated with a feeling of control over patients’ situation at home (Rho et al., 2014; Sharma, Barnett, & Clarke, 2010; Taylor et al., 2015). For patients using telehealth, the perceived benefits of telehealth may include a greater understanding of home-based rehabilitation, better relationships with health care practitioners, increased ability to receive instant feedback, and elevated feelings of security at home (Dinesen, Huniche, & Toft, 2013).

PEOU is defined as “the extent of which personal believes that using a certain system will be effortless.” (Fred D. Davis, 1989, p. 320). The concept of ease of use is similar to the concept of self-efficacy, which Bandura (1982) defined as “ judgment the course of execution required in dealing with certain expected situations.” (Bandura, 1982, p. 122). In general, people perform activities that they expect to be capable of doing and avoid activities that they believe to be beyond their capabilities. This also determines how much effort people exert and how long people face obstacles while performing new activities (Bandura, 1982). Research related to telehealth acceptance has revealed that users feel that telehealth is easy to use and learn (J. Finkelstein et al., 1998; Gagnon et al., 2012; Nikander et al., 2010; Rho et al., 2014; Taylor et al., 2015). Computer and Internet self-efficacy has also been associated with users' acceptance of telehealth (Duplaga, 2013; Zailani et al., 2014).

*The reliability and validity of the TAM constructs.* The validity of the TAM constructs' measurement scale has been reexamined in multiple studies. Davis et al. (1989) confirmed the reliability of the TAM in a study that included 107 participants. In this study, Davis et al. sought to predict the acceptance of a specific computer system. Also, Adams et al. (1992) evaluated how valid and reliable the TAM scales were (PU and PEOU scales) and examined the interaction between PU, PEOU, and system use. The two evaluations confirmed that PU and PEOU were both valid and reliable. Hendrickson et al. (1993) also examined the test-retest reliability of both PU and PEOU and established that as the TAM scales, they demonstrated a high degree of test-retest reliability.

Using the TAM is considered easy and simple. At the same time, the TAM is very powerful in identifying factors that influence acceptance of computer technology (Rho et al., 2014). The TAM has been used successfully to predict and explain users' acceptance of many new information technologies (Ashraf, Narongsak, & Seigyoung, 2014; Willard Van De & Saovapa, 2015). Since 1986, the TAM has been modified to understand users' intentions to use telehealth (Gagnon et al., 2012; Hu, Chau, Liu Sheng, & Kar Yan, 1999; Kowitlawakul, 2011; Rho et al., 2014). Although multiple studies have confirmed the TAM's validity and reliability, additional studies are needed to validate the TAM utilization, especially in the context of telehealth and telerehabilitation.

## Demographic Variables and Telehealth Acceptance

The relationships of the demographics age, gender, computer experience, working experience of health care practitioners, and disease duration for patients and the behavioral intentions to use telehealth have been examined in few studies. Kowitlawakul (2011) examined the influence of age, experience years in nursing, and experience years with computers on behavioral intentions to use telehealth and found no statistical support to include them in the model. In Kowitlawakul study, working experience in the hospital was found to have statistically significant correlation with PU. Venkatesh et al. (2003) concluded that gender and age of a user are important moderation of the relationships with the proposed telehealth acceptance model. In a study conducted by Gagnon et al. (2012), adding control variables age, gender, and a number of years in clinical practice did not improve the acceptance model. Duplaga (2013) concluded that patients' acceptance of telehealth was influenced by age, education level, chronic respiratory disease duration, and computer and Internet literacy.

## Determinants of Telehealth Acceptance: A Systematic Review

With the increased interest in telehealth activities, there is more focus on understanding users' intentions to use telehealth, especially when users are unfamiliar with telehealth. Users' acceptance of telehealth is suggested as one of the determinants of future use and adherence to telehealth services (Huis in 't Veld et al., 2010). Specifically, health care practitioners' acceptance of telehealth is the key factor affecting the success and sustainability of telehealth programs (V. A. Wade et al., 2014). Lack of staff acceptance of telehealth has been found to be one of the potential barriers to telehealth implementation (Brewster et al., 2014). Understanding potential users' acceptance of telehealth will lead to successful, higher quality, and safer implementation of telehealth programs (Asaro, Williams, & Banet, 2004). However, non-acceptance among potential telehealth users may lead to low levels of utilization of the proposed telehealth program (Jayasuriya & Caputi, 1996). Also, patients with low levels of telehealth acceptance might use the telehealth services less, which might reduce the potential benefits of the program (Huis in 't Veld et al., 2010).

Research in the literature focused on the issues of early telerehabilitation implementations such as feasibility, technical reliability, and clinical outcomes. The few existing studies suggest that providing PR services for patients with chronic diseases was feasible and associated with clinical and social benefits (Burkow et al., 2013; Anne E. Holland et al., 2013; Zanaboni et al., 2013). These studies also reported data about participants' acceptance of the proposed telehealth programs. Conclusions from these studies were inconclusive and limited in generalizability. The acceptance measurement scales utilized in the reviewed studies were lacking theoretical frameworks that could demonstrate the relationships between the acceptance determinants (Almojaibel, 2016).

**Review goal.** This is a systematic review of quantitative, qualitative, and mixed methods studies that explored telehealth acceptance. The intention of the researcher was to explore the research field of telehealth acceptance among health care practitioners and patients with chronic respiratory diseases. Findings of this review will help to identify the main determinants of telehealth acceptance. They shall help to identify the most valid and reliable acceptance measurement method to be used to measure acceptance of using telerehabilitation.

**Review methods.** Multiple search strategies were used to conduct this systematic literature review using electronic databases CINAHL, Ovid MEDLINE, and PubMed databases. Key words for the search included: *acceptance* and *adoption determinants* in together with *telehealth*, *telemedicine*, *telecare*, *tele-homecare*, *telerehabilitation*, and *video conferencing.* The researcher also examined the reference lists of the chosen articles to establish further studies that had not been identified in the search.

In this review, telehealth was defined as the application of the telecommunication technologies (e.g., Internet and cell phones) to provide and support the provision of health care services for patients at home. The articles were included for this review if they were: a) English-language publications, b) research articles that measured acceptance of telehealth systems, c) research studies that included patients with chronic respiratory diseases and care givers, and d) scholarly studies that explored telehealth acceptance of health care practitioners and/or managerial staff. This review included all research studies published before March 2015. Research studies that explored acceptance of using telehealth technologies in intensive care units (ICU) or used to facilitate patients with a disability were excluded from the review because they do not involve providing health care for patients at home via telecommunication technologies.

**Findings.** The electronic searches resulted in more than 1,900 articles. Based on titles and abstracts screening only, 39 articles have met the inclusion criteria. After looking at the 39 articles' full-texts, 28 articles were excluded, and only 11 studies were included in the analysis.  The 28 articles were excluded for three reasons: some were editorials, some included populations rather than patients with chronic respiratory diseases, and some used telehealth that provided teleconsultation only between health care providers in rural areas and specialized health care centers.

This review included 11 studies that measured acceptance of telehealth among health care practitioners and patients with chronic respiratory diseases.  Out of the 11 studies, 6 investigated health care practitioners' and managerial staffs' acceptance of telehealth.  Four studies measured telehealth acceptance among patients and caregivers, while only one study reported the factors that influenced telehealth acceptance of both patients and health care practitioners.  Of the 11 studies included, four were qualitative while seven were quantitative.  Of the quantitative studies, multiple theories and models that explained behavioral intention were utilized to design the acceptance measurement scales.  The qualitative studies mainly used semi-structured interviews to explore participants' acceptance of telehealth.  Tables 6 and 7 provide purpose summary, theoretical frameworks, sample sizes, various telehealth types, and findings of the 11 studies.

Table 6
*Quantitative Studies Investigated Health Practitioners and Patients' Acceptance of Telehealth*

| Author (s), Date, Location | Purpose of the Study | Theoretical Framework Used | Sample Size | Telehealth Technology | Findings |
|---|---|---|---|---|---|
| Zailani et al. (2014), Malaysia. | To explore the determinants of telehealth acceptance in selected public hospitals in Malaysia. | Specialty designed questionnaire based on previous studies. | 177 (51 physicians and 66 nurses). | Telehealth technologies to exchange health information and provide health care services. | Government policies, management support, perception of usefulness, and computer self-efficiency have a significant influence on telehealth acceptance. |
| Rho, M et al. (2014), Republic of Korea. | To develop a theoretical model aiming to better understand the variables that affect acceptance of telehealth usage by physicians. | Technology acceptance model (TAM) in addition to self-efficacy, accessibility of medical records, accessibility of patients, and perceived incentives. | 183 physicians. | Telemonitoring between physicians in hospitals and patients at home. | Perceived usefulness and perceived ease of use were critical factors in telehealth acceptance. |
| Gagnon et al. (2012), Spain. | To evaluate the acceptance of telehealth system by health care professionals. | Technology acceptance model (TAM), attitude, compatibility, subjective norm, facilitators, and habit. | 93 nursing staff and physicians | The program consisted of patient self-measurements Of vital signs twice a day. | TAM constructs were good predictive of health care professional's intention to use telehealth. |
| Hu et al. (1999), China. | To investigate the factors affecting physicians' acceptance of telehealth technology. | Technology acceptance model (TAM). | 408 physicians. | Telehealth in general (with no specific application or technology). | The study confirmed applicability of TAM to measure physicians' acceptance of using telehealth. |

Table 6 (Continued).
*Quantitative Studies Investigated Health Practitioners and Patients' Acceptance of Telehealth*

| Author (s), Date, Location | Purpose of the Study | Theoretical Framework Used | Sample Size | Telehealth Technology | Findings |
|---|---|---|---|---|---|
| Chau et al. (2012), China. | To investigate the feasibility, acceptance and effectiveness of using telehealth on patients with chronic pulmonary diseases. | A self-developed 10-item user satisfaction questionnaire was used to measure users' satisfaction with telehealth. | 22 patients. | A telehealth program to monitor patients' oxygen saturation, pulse rate, and respiratory rate to be transmitted to a community nurse in the health center. | The telehealth system was necessary and useful to help them to mange their disease at home. Telehealth helped to get easy access to health cares professional. |
| Finkelstein et al. (1998), USA. | To determine factors of acceptance of Internet-based home telemonitoring among patients with asthma. | A questionnaire collected data about patients' background, computer literacy, and patients' attitude toward the telemonitoring system. | 17 patients. | A computer based program used to enter their symptoms in a daily bases and to communicate with the health care center. | Telehealth can be successfully implemented in the group of patients without previous computer background. |

Table 7

*Qualitative Studies Investigated Health Practitioners and Patients' Acceptance of Telehealth*

| Author (s), Date, Location | Purpose of the Study | Theoretical Framework Used | Sample Size | Telehealth Technology | Findings |
|---|---|---|---|---|---|
| Taylor et al. (2015), UK. | To assesse the acceptance of telehealth among frontline staff working in community nursing settings. | Semi-structured interviews. | 105 interviews. 84 frontline staff and 21 managerial staff. | Telehealth program for remote monitoring patients with COPD and heart failure. | Factors preventing staff acceptance of telehealth can be categorized to five themes. Addressing these barriers is essential to ensure successful adoption of telehealth intro routine practice. |
| Dinesen et al. (2013), Danish. | To assesse patients with COPD attitudes toward using telerehabilitation on home settings. | Semi-structured interview. | 22 patients. | Home-based Telerehabilitation to send patients' exercise data to the rehabilitation center. | Patients' attitude toward the telerehabilitation program was influenced by the program benefits. |
| Sharma et al. (2010), United Kingdom | To explore nurses' and technicians' perception about using telehealth. | The study utilized the concepts from Giddens' structuration theory (ST) | 16 nurses and technicians. | Telemonitoring of patients with chronic conditions. | Trust and security are very essential factors that affect clinicians' acceptance of telehealth. |
| Mair et al. (2008), United Kingdom | To identify the factors that inhibited or promoted the use of telehealth for patients with chronic lung disease. | An ethnographic study and semi-structured interviews. | 9 patients and 11 nurses. | Telehealth for monitoring and managing exacerbations of COPD. | Factors categorized to: equipment issues, communication issues, effect on professional-patient relationship, attitude, changing the responsibilities, and medico-legal issues. |

### Analysis of the studies.

***Quantitative studies investigated health care practitioners' and patients' acceptance of telehealth.*** *Health care practitioners' acceptance of telehealth.* The majority of the studies that explored telehealth acceptance among health care practitioners were theoretically based on the TAM. Only one of the reviewed studies has designed a new model that is based on multiple theoretical frameworks and previous studies (Zailani et al., 2014). Rho et al. (2014) proposed the telehealth service acceptance (TSA) model that is based on the TAM and has four additional constructs. The added constructs are self-efficacy, accessibility of medical records, accessibility of patients, and perceived incentives. The findings of the study suggested that PU and PEOU are the two important variables in telehealth acceptance as proposed in the original TAM. The accessibility of medical records, accessibility of the patients to the care, and perceived incentives were also found to be essential variables to accept telehealth. Gagnon et al. (2012) found that using the TAM with additional constructs compatibility, facilitators, subjective norm, and habits, showed good correlation between them as well as with the dependent variable (intention to use). Gagnon et al. (2012) concluded that PU and PEOU were good predictors of health care practitioners' affinity towards the use of telehealth. When other variables are added, the model is still significant and more powerful in explaining the variance (Gagnon et al., 2012). Also, Hu et al. (1999) established the adequacy and applicability of the TAM to measure physicians' acceptance of using telehealth. This research team recommended that future studies add additional moderating variables to the TAM. Zailani et al. (2014) developed a structured questionnaire with validated items culled from previous studies. Factors related to government policies, top management support, the perception of usefulness, and affluence in using computers were found to have significant influences on telehealth acceptance among nurses and physicians. The results also suggested that culture has a moderating effect on government policies and perceived usefulness by users (Zailani et al., 2014).

*Patients' acceptance of telehealth.* Only a few studies explored telehealth acceptance of patients. Measurements of telehealth acceptance in these studies were taken during the implementation phase of new telehealth programs. Chau et al. (2012) measured chronic pulmonary diseases patients' telehealth acceptance using a specially designed questionnaire and three open-ended questions. The study found that the perceived benefits of telehealth were associated with acceptance of the program. Nikander et al. (2010) used a questionnaire designed specifically to evaluate acceptance of a telehealth-based aerosol system (Prodose AAD System). Nikander and colleague found that the high confidence and PEOU of the system indicated a high acceptability of telehealth among patients with cystic fibrosis. Finkelstein et al. (1998) studied the acceptance of telehealth of patients with asthma using a specially designed questionnaire, finding that the factors that potentially influencing patients' acceptance of telehealth are perceived ease of use and perceived benefits.

***Qualitative studies explored acceptance of telehealth.*** Two of the reviewed qualitative studies explored telehealth acceptance among staff and nurses. Taylor et al. (2015) concluded that factors influencing frontline staff acceptance of telehealth could be categorized into five themes. First, policy and practice development and the move to a paperless system were all considered as added workload and barriers to the use of telehealth. Second, the introduction of telehealth to the staff was very important in acceptance. Some participants were uncertain about the role of telehealth, its cost, and its effectiveness. Training on telehealth was reported as an important factor that might enhance acceptance. Third, negative and positive experiences with telehealth affected staff's attitude toward telehealth. Fourth, sharing experiences between staff of different health care sites helped the staff to understand the telehealth system better. Fifth, integrating telehealth into daily practice increased the staff's knowledge on telehealth and increased their confidence and interest in using the system (Taylor et al., 2015). Also, Sharma et al. (2010) suggested that nurses and technicians' views of telehealth were affected by the perceived reliability of the data transmitted via telehealth and the perceived control over the patients' situations at home.

Patients' acceptance of using telehealth was also explored in two studies. Mair, F. S., Hiscock, J., & Beaton, S. C. (2008) conducted semi-structured interviews with nine patients and 11 nurses who were participating in a telehealth program. Study results showed that factors influencing telehealth acceptance could be categorized as such: equipment issues, dissatisfaction with the workability of the telehealth interaction, the effect on the professional-patient relationship, attitude toward the telehealth, changing the work and responsibilities that patients and nurses are supposed to perform, medico-legal issues, and impact of telehealth on professional identity. Dinesen et al. (2013) found that patients' attitude toward the telerehabilitation program was influenced by the program benefits. Patients reported that telerehabilitation provided with the ability to adjust their training to their environment and daily life, and provided the feeling of security at home.

**Discussion and conclusion.** This review objective was to explore the research field of telehealth acceptance among health care practitioners and chronic respiratory diseases patients. Even though the number of the included studies was small, the retrieved information out of these studies is very valuable. This review covered quantitative, qualitative, and mixed methods studies that explored telehealth acceptance. The majority of the studies that explored telehealth acceptance among health care practitioners were based on the TAM as a theoretical framework. The reviewed studies explored acceptance of using different telehealth technologies. The definitions of telehealth varied in the included studies. The majority of the studies defined telehealth as the general use of the Internet by health care practitioners to monitor patients' vital signs and exercise data. Only one study explored the acceptance of using a telehealth enabled aerosol system (Nikander et al., 2010). None of the included studies explored acceptance of using the telerehabilitation among both health care practitioners and patients. Recently, one study utilized the unified theory of acceptance and use of technology to examine factors affecting the therapists' acceptance of new technologies (L. Liu et al., 2015). Liu et al. did not report the process of the content validity of the scales' items. Face validity in this study was conducted with five health care practitioners working in the rehabilitation program. No detailed information about the data-collection process was reported in this study. The telerehabilitation system in this article was defined as the utilization of modern technologies in health care settings. Telerehabilitation technologies in Liu et al.'s study included mechanical and computer systems used by therapists to improve patients' functions. The scope of telerehabilitation in the study conducted by Liu et al. was different than that of the telerehabilitation practice of interest in our acceptance measurement, which focused on the use of telecommunication technologies to provide and receive rehabilitation services for patients at home.

### Gap in the Literature

Telehealth is a growing field of practice, especially over the last two decades. Parallel to telehealth, there is increasing interest in the rehabilitation field regarding the use of telehealth. The majority of published studies in the telerehabilitation field have focused on the feasibility and outcomes of telerehabilitation programs. Understanding potential users' intentions to use telerehabilitation is a key factor in ensuring successful and prolonged implementation (Asaro et al., 2004). However, intentions of health care practitioners and patients to use telerehabilitation have never been measured. The telehealth acceptance factors in the literature were based on studies that defined telehealth as utilization of telecommunication technologies, and they lacked theoretical frameworks.

With the current expansion in telecommunication technologies utility in the daily life activities, factors affecting acceptance of telehealth would be different from those identified in the past years. The technology acceptance scales that have been developed in previous studies have been tested in contexts different than telerehabilitation and may not be valid for explaining telerehabilitation acceptance of health care practitioners and patients with chronic respiratory diseases. Identifying the determinants of telerehabilitation acceptance is an essential step before the implementation phase of any telerehabilitation program. It will help not only to predict future adoption but also to develop appropriate solutions to address the potential barriers of telerehabilitation. Thus, to fully understand users' intentions to use telerehabilitation, acceptance must be explored with a population-specific scale that measures the multiple domains of acceptance. Measuring telerehabilitation acceptance determinants will help telehealth developers to design better systems that take in consideration patients and health care practitioners' needs.

# Chapter III: Methodology

## Introduction

The study's chief objective was to examine the applicability of the TAM to explain health care practitioners and patients' acceptance of telerehabilitation. The applicability of the TAM was examined by assessing whether Tele-Pulmonary Rehabilitation Acceptance Scale had evidence of validity and reliability. Tele-Pulmonary Rehabilitation Acceptance Scale is a modified version of the TAM intended to explain the acceptance of using telerehabilitation among health care practitioners and patients with respiratory conditions. The second goal of our study was to identify the significant demographic variables of health care practitioners and patients on their intentions to use telerehabilitation. Two cross sectional survey-based studies were conducted to collect data from health care practitioners and patients with chronic respiratory diseases in PR centers. The survey scales were based on the TAM constructs PU and PEOU. In this chapter, the choice of the TAM among other intention-based theories will be explained. This will include discussions of each construct of the TAM and its relation to the intention to use technology in general. This chapter also will discuss the settings, the participants, the data collection procedures, and the procedure for the data analysis of the two studies.

## The Research Theoretical Model

The basis of this study's theoretical model was a modified version of the TAM. According to the TAM, PU and PEOU play major roles as behavioral intention (BI) direct predictors towards the use of technology (Figure 9).

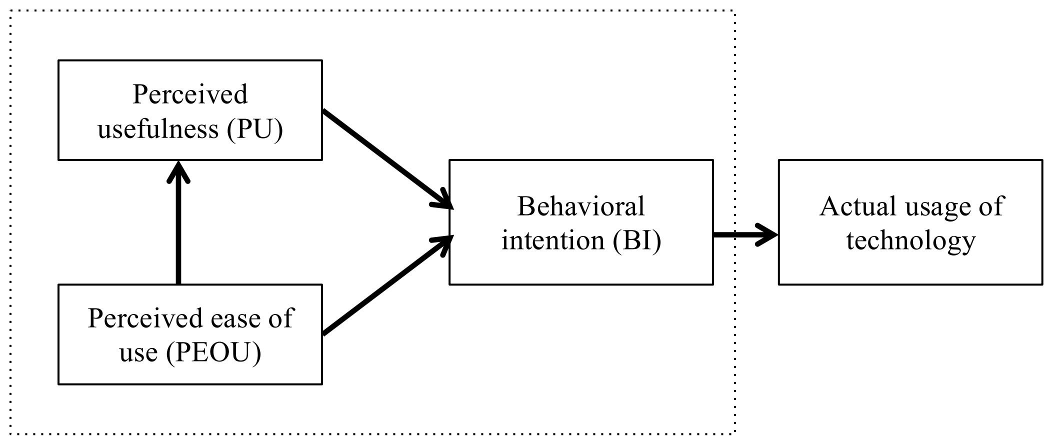


Figure 9. Technology acceptance model (TAM).

### Constructs of the TAM.

***Perceived usefulness (PU) and perceived ease of use (PEOU).*** Multiple studies have confirmed that PU and PEOU play an essential role in telehealth acceptance as suggested by the original TAM, and they are predictive of the intent to use telehealth (Gagnon et al., 2012; Hu et al., 1999; Kowitlawakul, 2011; Rho et al., 2014). In the context of using telerehabilitation, we hypothesize that PU and PEOU are predictors of the positive intention to use telerehabilitation. Positive intention to use telerehabilitation is associated with high PU and PEOU among potential users. Table 8 includes the original TAM constructs, their definitions, and the original items for measuring the TAM's constructs.

Table 8
*The Original TAM Constructs and Scales Items*

| Constructs | Scale items |
|---|---|
| Perceived usefulness (PU): "The degree to which a person believes that using a particular system would enhance his or her job performance" (F. D. Davis, 1989, p. 320). | • Using (…) in my job would enable me to accomplish tasks more quickly.<br>• Using (…) would improve my job performance.<br>• Using (…) in my job would increase my productivity.<br>• Using (…) would enhance my effectiveness on the job.<br>• Using (…) would make it easier to do my job.<br>• I would find (…) useful in my job. |
| Perceived ease of use (PEOU): "The degree to which a person believes that using a particular system would enhance his or her job performance" (F. D. Davis, 1989, p. 320). | • Learning to operate (…) would be easy for me.<br>• I would find it easy to get (…) to do what I want it to do.<br>• My interaction with (…) would be clear and understandable.<br>• I would find (…) to be flexible to interact with.<br>• It would be easy for me to become skillful at using (…).<br>• I would find (…) easy to use. |

***Behavioral intention (BI).*** The behavioral intention (BI) was measured as a dependent variable of the TAM constructs. Choosing the behavioral intention to use telerehabilitation instead of the actual usage of telerehabilitation as a dependent variable of the scales was because of 1) when the behavior is volitional, an individual's intention is the best single predictor of the actual performance (Fishbein & Ajzen, 1975), 2) there is a strong and significant causal association between behavior intention to adopt a behavior and the actual adoption of the behavior (P. Y. K. Chau & Hu, 2001), 3) intention is a very common variable in information technology research (Wilson & Lankton, 2004; Wu, Wen-Shen, Li-Min, Greenes, & Bates, 2008), and 4) in the case of telerehabilitation programs, measuring actual usage may be impractical in our study because of the lack of actual telerehabilitation programs to utilize. There is no specific questionnaire intended to measure behavioral intention. Therefore, formatting intention measuring items that target the behavior and population of each study is recommended (Ajzen, 2015). A sample of the items that were used in previous studies to measure behavioral intention can be seen in Box 2.

| Box 2<br>*Items Used to Measure Intention to Use Telehealth* |
|---|
| • I always try to use (…) to do a task whenever it has a feature to help me perform it.<br>• I always try to use (…) in as many cases as possible.<br>• I intend to use (…) in my patient care and management when it becomes available in my department or hospital.<br>• I have a positive intention to adopt (…).<br>• I will provide health services and share the information through (…). |

In light of the previous discussion and in the context of using telerehabilitation, this study hypothesized the following:

- The TAM constructs (PU and PEOU) demonstrate significant effect on the behavioral intention to use telerehabilitation.
- The TAM constructs (PU and PEOU) explain most of the variance of the intent to use telerehabilitation.

The secondary goal of our study was to examine the relationships between the demographics of the participants (external variables), the TAM constructs (PU and PEOU), and the intention to use telerehabilitation. For the details of the relationships between the potential predictors see Figure 10. The study examined the relationships between the age of the potential telerehabilitation users and the intention to use telerehabilitation. Age of the potential user may play a role in the telerehabilitation acceptance. Age could be a predictor of how users perceive usefulness as well as ease of use and therefore the intent to use telerehabilitation. Also, this study examined the relationships between years of experience in PR for health care practitioners and years of contracting the respiratory disease for patients and the high intention to use telerehabilitation. This study examined if working in PR for a long time may increase the probability of preferring not to use telerehabilitation in the future. Having significant working experience in PR may be considered as an influence to recognize the need for telerehabilitation and to appreciate its additional benefits. The number of years since having a respiratory disease may also encourage patients to have a high intention to use telerehabilitation. The physical limitation associated with chronic respiratory diseases could make it difficult for the patient to travel to the PR center and encourage the patients to use telerehabilitation from home. Moreover, the geographic location of the patient's residence could affect the intention to use telerehabilitation. Patients living in rural areas or locations very far from PR centers may tend to have positive intentions towards using telerehabilitation. For the health care practitioners, the type of PR program may also play a role in considering the use of telerehabilitation. The relationships between health care practitioners and patients' demographics and the intention to use telehealth, in general, were not conclusive. The effects of the telerehabilitation acceptance variables on the BI to use telerehabilitation were examined. The following hypothesis was drawn from this study:

- The participants' demographics (age, working experience in PR or disease duration, the distance from PR center, PR program type) would improve the percentage of variance explained by the TAM.

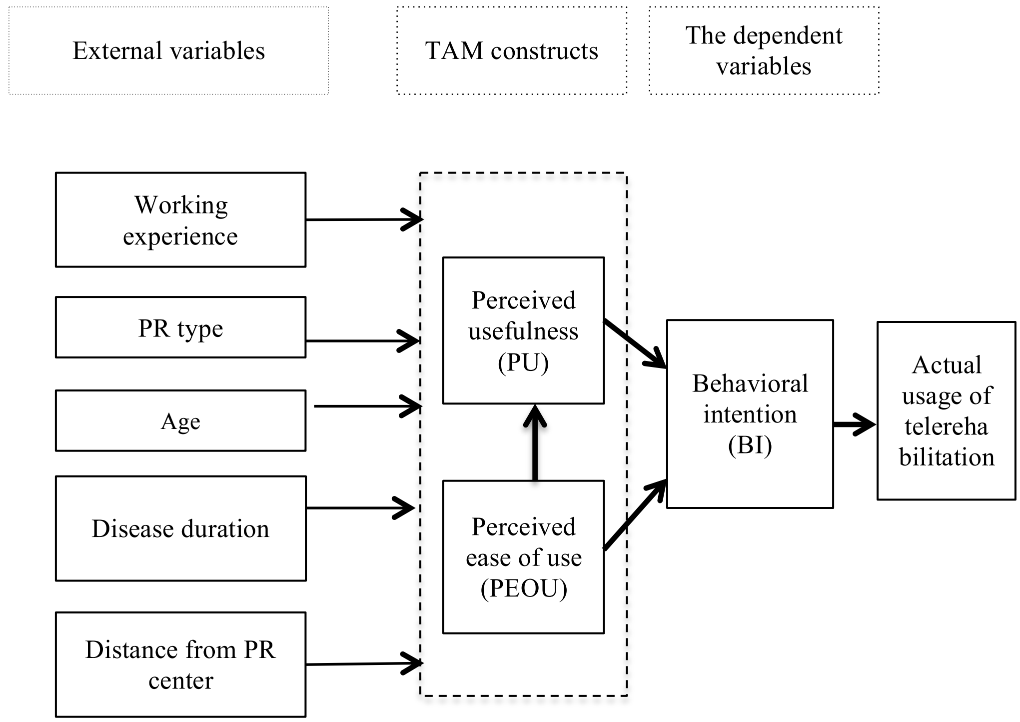


Figure 10. The Research Theoretical Model.

To accomplishment the research goals, the study consisted of two phases: 1) instrument development and 2) measuring acceptance of health care practitioners and patients. The content validity assessments included expert content validity evaluations, face validity evaluations, and content evaluations of the telerehabilitation information video and brochure.

## Phase I: Instrumentation

### Content validity assessment of the modified TAM items.

The content validity assessment of the Tele-Pulmonary Rehabilitation Acceptance Scale (TPRAS) consisted of three objectives: (a) constructing a modified scale based on the TAM, (b) judging the items for content validity, and (c) judging the scale for face validity.

***a) Constructing a modified version of the TAM items.*** The Tele-Pulmonary Rehabilitation Acceptance Scale (TPRAS) is intended to measure the intentions to use telerehabilitation among health care practitioners working in PR, and patients attending PR programs. The scale development process included the following steps: a) choosing the theoretical framework of the scale. The TAM and its constructs were the foundations of the TPRAS. The reasons for choosing the TAM were established early in this chapter. For the model constructs and their conceptual and operational definitions see Table 9, b) generating an item pool. The item pool was generated based on the TAM and on previous studies that examined telehealth acceptance using the TAM. The items were written as neutrally as to be used for both patients and health care practitioners.

Table 9
*The TAM's Constructs and Their Operational Definitions*

| Construct | Operational definition |
|---|---|
| Perceived usefulness (PU) | The degree to which a user believes that using telerehabilitation will be associated with clinical and other benefits. |
| Perceived ease of use (PEOU) | The degree to which a telerehabilitation user believes that using telerehabilitation would be free of effort. |
| Behavioral intention (BI) | The extent to which a potential user is ready to use the telerehabilitation system, or the likelihood of using telerehabilitation system. |

***b) Judging the items for content validity.*** To establish content validity, at least five reviewers should participate in the content validity assessment (Netemeyer, Sharma, & Bearden, 2003). In this content validity assessment, nine experts were invited to participate from the schools of nursing, health sciences, and information technology as well as from PR programs. For this content validity assessment, the experts must have one of the following: doctorate or master's degree in a field related to the research topic, papers published in the field of PR, telehealth information technology, or scale development, or have worked in the area of PR or telehealth. The content experts evaluated each item for wording, layout, clarity, redundancy, and relevance to the scale's domains based on the domains' theoretical definitions provided the data collection tool.

The Delphi technique aims to "get the experts' consensus with the highest degree of reliability through several intensive questionnaires which will be interspersed with controlled opinion feedback." (Linstone, 1975, p. 12). In this study, a modified Delphi method that started with offering some items that are available from the literature concerning telehealth acceptance were utilized (Bailie, 2012). The modified Delphi process in this study consisted of two rounds:

***Round 1***: Items retrieved from the literature review, PU and PEOU items, were randomly ordered and presented to the experts as one list. BI items were also presented to reviewers as a separate list. Experts in the review panel performed two evaluations for each item in the PU and PEOU item pool. First, reviewers categorized each item as falling under the PU or PEOU domain. Second, the experts evaluated each item's relevance to the assigned domain using a 4-point Likert scale: 1 = *not relevant*, 2 =

*relevant, needs major revision*, 3 = *moderately relevant, needs minor revision*, and 4 = *very relevant, no modification*. The reviewers also evaluated the relevance of the behavioral intention (BI) items using the same 4-point Likert scale. Additionally, reviewers provided comments and suggestions on how to improve the relevance and clarity of each item. Also, the experts reviewed demographic questions and suggested modifications and additional questions to be included in the survey. See Appendix A for the reviewers' data-collection tool for content validity.

***Round 2*:** Items with high scores on the item content validity index (I-CVI) ≥ .83 from Round 1 were included in this evaluation. Only a few items with a CVI ≤ .83 were included in Round 2 after being modified based on the reviewers' suggestions. In the data-collection tool for Round 2, each item was followed by a dichotomous scale with two options for inclusion: YES or NO. The experts also provided feedback on how to improve the items and have suggested writing two different instruments (one for each group of participants) instead of one instrument for both groups of the potential participants. Thus, the nine reviewers in Round 2 received two versions of the instrument. Instrument 1 (patient instrument) included items intended to measure patients' PU, PEOU, and BI to use telerehabilitation. Instrument 2 (health care practitioner instrument) included items intended to measure health care practitioners' PU, PEOU, and BI to use telerehabilitation. See Appendix B for the data-collection tool for Round 2.

***c) Judging the instruments for face validity.*** Face validity "refers only to the appearance of the instrument to the layperson; that is if upon cursory inspection, an instrument appears to measure what the test constructors claim it measures, it is said to have face validity." (Dr. Carolyn F. Waltz, Dr. Ora Lea Strickland, & Dr. Elizabeth R. Lenz, 2010, p. 166). In this study, face validity is the extent to which the TPRAS reflects factors that affect acceptance of using telerehabilitation in the future. Seven health care practitioners working in PR programs participated in this assessment, including one physician, two nurses, one physiotherapist, and three respiratory therapists. During in-person interviews, phone calls, or emails, each participant was provided the final version of the TPRAS in both electronic and paper-based formats. Participants were asked to read the survey instructions and answer the survey questions. Feedback was obtained by asking participants to answer the following open-ended questions: (a) "How do you rate the scale's instruction and items regarding clarity and ease of reading?" (b) "How do rate the clarity of the demographic questions?" and (c) "Do you suggest additional questions for the demographic survey?"

**Findings of the content validity assessments.** Of the 15 invitees, nine experts agreed to participate and completed the evaluation form. Data from Round 1 were summarized and presented based on evaluation forms completed by the nine reviewers. Items were categorized based on the reviewers' evaluations (Table 10). The I-CVI was calculated for each item (Tables 11 and 12). An item's I-CVI is the number of reviewers giving a rating of either 3 or 4 for an item (*moderately relevant* or *very relevant*) divided by the total number of reviewers (Polit & Beck, 2006). Based on the number of experts in this review panel (nine), a minimum I-CVI of $\geq .78$ would be accepted as valid (Lynn, 1986). To construct scales for PU and PEOU, items with an I-CVI of $\geq .83$ were directly included in the scale to be evaluated in Round 2. Of the 30 items in the PU and PEOU item pool, 14 were rated with an I-CVI of $\geq .83$. Only three items from the PU and PEOU items pool with I-CVIs of .78 were included in the final item list (items 5, 11, and 20). One of the three items was modified based on reviewers' feedback. From the BI item pool, three items met the cutoff criteria (I-CVI $\geq .83$). One item was rated with an I-CVI of .78 (BI 1). This item was modified based on the reviewers' feedback and was included in the BI measuring items to be evaluated in Round 2. Scale-CVI was calculated for each subscale. Scale-CVI is the proportion of high-rated items that received 3 or 4 in the 4-point relevance scale by the raters (Polit & Beck, 2006). Scale-CVIs (averages of I-CVIs) for the first evaluation round before elimination and revision for each of the subscales (PU and PEOU) and (BI) were .84 and .80, respectively.

Table 10
*Items Categorization Based on reviewers' Evaluation from Round 1*

| # | Items Pool | Raters' CVI | Assigned Category |
|---|---|---|---|
| 1 | Telerehabilitation will allow me to do my tasks more quickly | .55 | PEOU |
| 2 | Telerehabilitation will allow me to accomplish more than face-to-face rehabilitation | .67 | PU |
| 3 | Telerehabilitation will give me greater control over my disease symptoms. | .89 | PU |
| 4 | Telerehabilitation will save me time | .67 | PU |
| 5 | Telerehabilitation will be flexible to use | .89 | PEOU |
| 6 | Telerehabilitation will improve access to the rehabilitation programs | .89 | PU |
| 7 | Learning to operate the telerehabilitation equipment will be easy for me | 1.00 | PEOU |
| 8 | It will be easy to get the telerehabilitation equipment to do what I want it to do | 1.00 | PEOU |
| 9 | My interaction with the telerehabilitation equipment will be clear | .78 | PEOU |
| 10 | Telerehabilitation will be easy to use | .89 | PEOU |
| 11 | Providing/ Receiving pulmonary rehabilitation services using telerehabilitation will be more convenient | .56 | PU |
| 12 | Using telerehabilitation technology will be understandable | .89 | PEOU |
| 13 | Telerehabilitation will meet my needs | .78 | PU |
| 14 | Using Telerehabilitation will improve my performance | .78 | PU |
| 15 | Telerehabilitation will increase the quality of the pulmonary rehabilitation services | .78 | PU |
| 16 | Telerehabilitation will improve my attendance in the rehabilitation program | .78 | PU |
| 17 | Telerehabilitation will cancel transportation difficulties in getting to the rehabilitation center | .67 | PU |
| 18 | It will be easy for me to become skillful in using telerehabilitation equipment | .89 | PEOU |
| 19 | Telerehabilitation will decrease the cost of the rehabilitation program | .67 | PU |
| 20 | Using telerehabilitation will be simple | 1.00 | PEOU |
| 21 | Telerehabilitation will facilitate monitoring of the disease | 1.00 | PU |
| 22 | Telerehabilitation will give me the feeling of being safe | .78 | PU |
| 23 | Telerehabilitation will improve the rehabilitation plan | 1.00 | PU |
| 24 | Telerehabilitation will give me the feeling of being continuously monitored | .89 | PU |
| 25 | Telerehabilitation could help me provide/ receive care more quickly | .89 | PU |
| 26 | Education sessions will be easier when using telerehabilitation. | .78 | PEOU |
| 27 | Telerehabilitation will be useful in the rehabilitation program | 1.00 | PU |
| 28 | Telerehabilitation will save me time of travelling to the health care center | .56 | PU |
| 29 | Telerehabilitation will improve the relationship between the health care provider and the patient | 1.00 | PU |
| 30 | Telerehabilitation does not require a lot of my mental effort | .89 | PEOU |

PU = Categorized as perceived usefulness.
PEOU = Categorized as perceived ease of use.

Table 11
*Perceived Usefulness and Perceived Ease of Use Items' CVIs and S-CVI From Round 1*

| # | Items Pool | Item CVI |
|---|---|---|
| 1 | Telerehabilitation will allow me to do my tasks more quickly | .78 |
| 2 | Telerehabilitation will allow me to accomplish more than face-to-face rehabilitation | .78 |
| 3 | Telerehabilitation will give me greater control over my disease symptoms | .78 |
| 4 | Telerehabilitation will save me time | **.89** |
| 5 | <u>Telerehabilitation will be flexible to use</u> | .78 |
| 6 | Telerehabilitation will improve access to the rehabilitation programs | **.89** |
| 7 | Learning to operate the telerehabilitation equipment will be easy for me | **1.00** |
| 8 | It will be easy to get the telerehabilitation equipment to do what I want it to do | .67 |
| 9 | My interaction with the telerehabilitation equipment will be clear | .67 |
| 10 | Telerehabilitation will be easy to use | **1.00** |
| 11 | <u>Providing/ Receiving pulmonary rehabilitation services using telerehabilitation will be more convenient</u> | .78 |
| 12 | Using telerehabilitation technology will be understandable | .78 |
| 13 | Telerehabilitation will meet my needs | .78 |
| 14 | Using Telerehabilitation will improve my performance | .78 |
| 15 | Telerehabilitation will increase the quality of the pulmonary rehabilitation services | .78 |
| 16 | Telerehabilitation will improve my attendance in the rehabilitation program | **1.00** |
| 17 | Telerehabilitation will cancel transportation difficulties in getting to the rehabilitation center | **1.00** |
| 18 | It will be easy for me to become skillful in using telerehabilitation equipment | **.89** |
| 19 | Telerehabilitation will decrease the cost of the rehabilitation program. | .67 |
| 20 | <u>Using telerehabilitation will be simple</u> | .78 |
| 21 | Telerehabilitation will facilitate monitoring of the disease | **.89** |
| 22 | Telerehabilitation will give me the feeling of being safe | .56 |
| 23 | Telerehabilitation will improve the rehabilitation plan | .78 |
| 24 | Telerehabilitation will give me the feeling of being continuously monitored | **1.00** |
| 25 | Telerehabilitation could help me provide/ receive care more quickly | **1.00** |
| 26 | Education sessions will be easier when using telerehabilitation | **.89** |
| 27 | Telerehabilitation will be useful in the rehabilitation program | **.89** |
| 28 | Telerehabilitation will save me time of travelling to the health care center | **1.00** |
| 29 | Telerehabilitation will improve the relationship between the health care provider and the patient | **.89** |
| 30 | Telerehabilitation does not require a lot of my mental effort | .67 |

S-CVI = the proportion of items that achieved a rating of 3 or 4 by all the reviewers.
S-CVI Ave = average of the I-CVIs. S-CVI = .84.
<u>Underlined item</u>: items with ICV ≤ .78 and included in the next evaluation after revision.

Table 12
*Behavioral Intention Items' CVIs and S-CVI From Round 1*

| # | Items Pool | Item CVI |
|---|---|---|
| BI 1 | <u>I am positive toward using the telerehabilitation</u> | .78 |
| BI 2 | I will use the telerehabilitation when it becomes available | **.89** |
| BI 3 | I am willing to use telerehabilitation to provide/receive pulmonary rehabilitation services | **.89** |
| BI 4 | I will use the telerehabilitation to provide/receive pulmonary rehabilitation services as often as needed | **1.00** |
| BI 5 | I will use the telerehabilitation to provide/receive pulmonary rehabilitation services rather than the traditional face-to-face sessions | .67 |
| BI 6 | I will usually use telerehabilitation | .56 |

BI1- BI6 = Behavioral intention items.
S-CVI = the proportion of items that achieved a rating of 3 or 4 by all the reviewers.
S-CVI Ave = average of the I-CVIs. S-CVI = .80.
<u>Underlined item</u>: items with ICV ≤ .78 and included in the next evaluation after revision.

All items with CVIs of ≥ .83 were used to create two lists of items (PU or PEOU) based on reviewers' categorization. Only three items with CVIs of ≤ .78 were included. Item 28 was excluded because it measured a concept similar to that measured by items 4 and 17. In addition, the reviewers suggested adding one new item, "telerehabilitation will facilitate monitoring of the patients' daily activities." (item 31). This item was included to the item list and was evaluated by the reviewers for inclusion in Round 2. The experts suggested writing two scales: one intended to measure acceptance of using telerehabilitation among health care practitioners and one intended to measure acceptance of using telerehabilitation among patients with chronic respiratory diseases. Therefore, items retrieved from Round 1 were listed in two scales. Each scale consisted of three subscales: PU, PEOU, and BI.

In Round 2 evaluation, only seven completed evaluation forms were returned by the experts on the review panel. I-CVI was calculated for each item. See Tables 13, 14, and 15 for CVIs for patients' items from Round 2. See Tables 16, 17, and 18 for CVIs for health care practitioners' items from Round 2. Items with high CVIs $\geq 0.78$ were included in the final version of the scales. Only one item with a CVI of 0.71 was included in the patients version of the scale (item 10), and only one item with a CVI of 0.71 (item 7) was included in the health care practitioners version of the scale. Both items were highly recommended by the reviewers in Round 1 to be included in the final scale. The two items 7 and 10 were included in the final versions of the scale to be further evaluated during the face validity assessment and reliability tests.

Table 13
*Patients' PU Items' CVIs from Round 2 Evaluation*

| Item # | Items | Item CVI |
|---|---|---|
| 4 | Telerehabilitation will save me time | .71 |
| 6 | Telerehabilitation will improve my access to rehabilitation programs | **1.00** |
| 16 | Telerehabilitation will improve my attendance in the rehabilitation program | **.86** |
| 17 | Telerehabilitation will eliminate transportation difficulties in getting to the rehabilitation center | **1.00** |
| 24 | Telerehabilitation will give me the feeling of being continuously monitored | .71 |
| 25 | Telerehabilitation could help me to receive care more quickly at home | **.86** |
| 27 | Telerehabilitation will be useful in the rehabilitation program | **1.00** |
| 29 | Telerehabilitation will improve my communication with the health care provider | **1.00** |

S-CVI = .71 +1.00 +.86 +1.00 + .71 + .86 + 1.00 + 1.00/8 = .89. (Prior to exclusion).

Table 14
*Patients' PEOU Items' CVIs from Round 2 Evaluation*

| Item # | Items | Item CVI |
|---|---|---|
| 5 | Telerehabilitation will be flexible to use | .71 |
| 7 | Learning to operate the telerehabilitation equipment will be easy for me | **.86** |
| 10 | Telerehabilitation will be easy to use | .71 |
| 11 | Receiving pulmonary rehabilitation services at home using telerehabilitation will be more convenient | **.86** |
| 18 | It will be easy for me to become skillful in using telerehabilitation equipment | .42 |
| 20 | Using telerehabilitation will be simple | .71 |
| 26 | Education sessions will be easier when using telerehabilitation | **1.00** |

S-CVI = .71 + .71 + .86 + .42 + .71+ 086 + 1.00/ 7 = .75. (Prior to exclusion).
Underlined item: items with ICV ≤ .78 and included in the next evaluation after revision.

Table 15
*Patients' Behavioral Intention (BI) Items' CVIs from Round 2 Evaluation*

| Item # | Items | Item CVI |
|---|---|---|
| BI 1 | I feel positive about using telerehabilitation | .71 |
| BI 2 | I will use telerehabilitation when it becomes available in my rehabilitation center | .71 |
| BI 3 | I will plan to use telerehabilitation to receive pulmonary rehabilitation services | **1.00** |
| BI 4 | I will use telerehabilitation to receive pulmonary rehabilitation services as often as recommended by my provider | **.86** |

S-CVI = .71 + .71 + 1.00 +.86/ 4 = .82.

Table 16
*Health Care* Practitioners' *PU Items' CVIs from Round 2 Evaluation*

| Item # | Items | Item CVI |
|---|---|---|
| 4 | Telerehabilitation will save me time | **1.00** |
| 6 | Telerehabilitation will improve patients' access to rehabilitation programs | **1.00** |
| 16 | Telerehabilitation will improve patients' attendance in the rehabilitation program | **1.00** |
| 21 | Telerehabilitation will facilitate monitoring of the patients' disease symptoms | **1.00** |
| 25 | Telerehabilitation could help me to provide care more quickly for patients at home | **1.00** |
| 27 | Telerehabilitation will be useful in the rehabilitation program | **1.00** |
| 29 | Telerehabilitation will improve my communication with the patients | **.86** |
| 31 | Telerehabilitation will facilitate monitoring of the patients' daily activities | **.86** |

S-CVI = 1.00 + 1.00 + 1.00 + 1.00 + 1.00 + 1.00 + .86 + .86/8 = .97. (Prior to exclusion).

Table 17
*Health Care Practitioners' PEOU Items' CVIs from Round 2 Evaluation*

| Item # | Items | Item CVI |
|---|---|---|
| 5 | Telerehabilitation will be flexible to use | .71 |
| 7 | <u>Learning to operate the telerehabilitation equipment will be easy for me</u> | .71 |
| 10 | Telerehabilitation will be easy to use | **1.00** |
| 11 | Providing pulmonary rehabilitation services using telerehabilitation will be more convenient | **.86** |
| 18 | It will be easy for me to become skillful in using telerehabilitation equipment | .71 |
| 20 | Using telerehabilitation will be simple | .57 |
| 26 | Education sessions will be easier when using telerehabilitation | **1.00** |

S-CVI = .71 + .71 + 1.0 0 + .71 + .57 + 1.00 + .86/7 = .79. (Prior to exclusion).
<u>Underlined item</u>: items with ICV ≤ .78 and included in the next evaluation after revision.

Table 18
*Health Care Practitioners' Behavioral Intention (BI) Items' CVIs from Round 2 Evaluation*

| Item # | Items | Item CVI |
|---|---|---|
| BI 1 | I feel positive about using telerehabilitation | **.86** |
| BI 2 | I will use telerehabilitation when it becomes available in my rehabilitation center | **1.00** |
| BI 3 | I will use telerehabilitation to provide pulmonary rehabilitation services | **1.00** |
| BI 4 | I will use telerehabilitation to provide pulmonary rehabilitation services as often as recommended by the care team | **.86** |

S-CVI = .86 + 1.00 + 1.00 + .86/4 = .93. (Prior to exclusion).

**Findings of the face validity assessments.** The face validity assessments for the two versions of the scale were conducted by seven health care practitioners and four patients. One participant suggested adding an item to the PU scales. The suggested item was "telerehabilitation will improve patients' adherence in the rehabilitation program." This item was added to the final scales and was evaluated in the patients' face validity assessment. Moreover, the initial list of the demographic questions was evaluated during the face validity assessments. The newly suggested questions were (health profession, experience in health care, working hours, gender, and previous use of telehealth or telerehabilitation) for health care practitioners and (education level, Internet experience, type of reimbursement for the PR services, and type of transportation) for the patients. These demographic questions were used for the collection of the participants' demographic information.

The final items were divided into two scales. One scale was designed to measure telerehabilitation acceptance among patients with chronic respiratory diseases (Table 19), and the other was designed to measure telerehabilitation acceptance among health care practitioners working in PR programs (Table 20). Each scale included three subscales measuring two domains (PU and PEOU), in addition to a scale to measure the BI of both groups of potential participants.

Results of this content and validity assessments provided evidence of content and face validity of the TPRAS. The TPRAS demonstrated evidence of content validity as evaluated by a panel of experts in the fields of PR, telehealth, information technology, and scale development. The scales developed herein have been utilized to collect data from patients attending PR programs and health care practitioners working in PR programs.

Table 19
*Patients Version of the Telerehabilitation Acceptance Scale*

| Perceived Usefulness (PU) of Telerehabilitation | | *I-CVI* |
|---|---|---|
| 6 | Telerehabilitation will improve my access to rehabilitation programs | 1.00 |
| 16 | Telerehabilitation will improve my attendance in the rehabilitation program | .86 |
| 17 | Telerehabilitation will eliminate transportation difficulties in getting to the rehabilitation center | 1.00 |
| 25 | Telerehabilitation could help me to receive care more quickly at home | .86 |
| 27 | Telerehabilitation will be useful in the rehabilitation program | 1.00 |
| 29 | Telerehabilitation will improve my communication with the health care provider | 1.00 |
| 32 | Telerehabilitation will improve my commitment to the rehabilitation program | 0 |
| | Patients' PU Scale-CVI | .82 |
| Perceived Ease of Use (PEOU) of Telerehabilitation | | |
| 7 | Learning to operate the telerehabilitation equipment will be easy for me | .86 |
| 10 | Telerehabilitation will be easy to use | .71 |
| 11 | Receiving pulmonary rehabilitation services at home using telerehabilitation will be more convenient | .86 |
| 26 | Education sessions will be easier when using telerehabilitation | 1.00 |
| | Patients' PEOU Scale-CVI | .89 |
| Behavioral Intention (BI) to Use Telerehabilitation | | |
| BI 3 | I will plan to use telerehabilitation to receive pulmonary rehabilitation services | 1.00 |
| BI 4 | I will use telerehabilitation to receive pulmonary rehabilitation services as often as recommended by my provider | .86 |
| | Patients' BI Scale-CVI | .93 |

Table 20
*Health Care Practitioners Version of the Telerehabilitation Acceptance Scale*

| Perceived Usefulness (PU) of Telerehabilitation | | *I-CVI* |
|---|---|---|
| 4 | Telerehabilitation will save me time | 1.00 |
| 6 | Telerehabilitation will improve patients' access to rehabilitation programs | 1.00 |
| 16 | Telerehabilitation will improve patients' attendance in the rehabilitation program | 1.00 |
| 21 | Telerehabilitation will facilitate monitoring of the patients' disease symptoms | 1.00 |
| 25 | Telerehabilitation could help me to provide care more quickly for patients at home | 1.00 |
| 27 | Telerehabilitation will be useful in the rehabilitation program | 1.00 |
| 29 | Telerehabilitation will improve my communication with the patients | .86 |
| 31 | Telerehabilitation will facilitate monitoring of the patients' daily activities | .86 |
| 32 | Telerehabilitation will improve patients' adherence to the rehabilitation program | 0 |
| | Health Care Practitioner' PU Scale-CVI | .86 |
| Perceived Ease of Use (PEOU) of Telerehabilitation | | |
| 7 | Learning to operate the telerehabilitation equipment will be easy for me | .71 |
| 10 | Telerehabilitation will be easy to use | 1.00 |
| 11 | Providing pulmonary rehabilitation services using telerehabilitation will be more convenient | .86 |
| 26 | Education sessions will be easier when using telerehabilitation | 1.00 |
| | Health Care Practitioner' PEOU Scale-CVI | .89 |
| Behavioral Intention (BI) to Use Telerehabilitation | | |
| BI 1 | I feel positive about using telerehabilitation | .86 |
| BI 2 | I will use telerehabilitation when it becomes available in my rehabilitation center | 1.00 |
| BI 3 | I will use telerehabilitation to provide pulmonary rehabilitation services | 1.00 |
| BI 4 | I will use telerehabilitation to provide pulmonary rehabilitation services as often as recommended by the care team | .86 |
| | Health Care Practitioner' BI Scale-CVI | .93 |
| | Scale-CVI | **.83** |

**Content validity assessments of the telerehabilitation information video and the telerehabilitation brochure.** The TAM was originally designed to measure users' acceptance after receiving a hands-on demonstration of the new technology allowing the participants to rate their reactions (F. Davis, 1986). In an experiment conducted as a part of the TAM development, presenting new systems by a videotape, compared to hands-on interaction, appeared to enable participants to form accurate attitudes, usefulness perceptions, quality perceptions, and behavioral expectations regarding the proposed system (F. Davis, 1986). Using video demonstration enables researchers to present hypothetical systems (e.g., telerehabilitation), which may be not available for hands-on interaction. Also, this method will allow researchers to perform acceptance measures at remote sites with large number of subjects compared to hands-on interaction (F. Davis, 1986). To ensure all participants are exposed to the same telerehabilitation system before participation in this survey, telerehabilitation was introduced in two ways: 1) a brochure and 2) a short video showing clinical examples of telerehabilitation.

During content validity assessment, the expert panel and the potential users evaluated the telerehabilitation brochure and the telerehabilitation video for appropriateness and clarity. The expert panel conducted the first steps of the brochure and the video content validity evaluations. This panel included the same experts who conducted the content validity assessments of the item pool. During each interview, each expert read the telerehabilitation brochure that includes information about telehealth and its uses in the health care system and the rehabilitation field (see the telerehabilitation information brochure in Appendix C). The experts also watched the telerehabilitation example video to evaluate the appropriateness of this video for potential participants.

The Tele-Rehabilitation in the Home-Clinical examples is a 4:36 seconds length educational video, marked as standard YouTube license. The producer of the YouTube video was Flinders Telehealth's Home project and published on the 8th of September, 2014 (FlindersUniversity, 2014). This video shows a physiotherapist demonstrates two different exercises with a patient at home using an iPad. The video shows how to perform some balance exercises and arm exercises using the video cam on the iPad. This video was presented to all the participants to provide examples of the telerehabilitation, and not as a telerehabilitation system that will be implemented soon in their PR program. The level of agreement among expert raters was calculated for the brochure and the video clip evaluations. The level of agreement among the raters on the video and the brochure evaluations was high; therefore, the same video and brochure were presented for each potential participant before taking the survey.

To draw a full picture of the telerehabilitation acceptance, the TPRAS scales were introduced to two groups of the potential users of the telerehabilitation programs. Phase II of this research study consisted of two studies. Study 1 evaluated the TAM to explain the intention of health care practitioners working in PR to use telerehabilitation, and Study 2 examined the applicability of the TAM to explain the intention of patients with chronic respiratory conditions attending PR to use telerehabilitation.

**Ethical Approval**

This study was approved by the Indiana University Institutional Review Board. Those participating were informed of the study's purpose and methods. They were also informed that participation in this study was voluntary and that their responses would be confidential.

## Phase II: Measuring Telerehabilitation Acceptance

**Study 1: Health care practitioners' determinants of telerehabilitation acceptance.** The principal goal of this study was to examine the applicability of the TAM in predicting telerehabilitation acceptance among health care practitioners working in PR programs. The secondary goal was to evaluate the determinants of the positive intention to utilize telerehabilitation among health care practitioners.

***Participants.*** The study targeted health care practitioners working in PR programs. A convenience sample was recruited for participation from PR programs across the world. Participants will be eligible if they: 1) read and write in English, and 2) are health care practitioners who are currently working in a rehabilitation center. This group of participants included all the health care professionals (physicians, nurses, physical therapists, respiratory therapists, and occupational therapists) who are involved or have participated in providing traditional face-to-face PR services. Medical and health care professional students were excluded from participation in this survey.

***Data Collection.*** The data collection method for this review was a self-administered Internet-based survey. The electronic survey was provided to the potential participants via a link to the REDCap website. The first page of the survey included information about the study's purpose and a consent to participate. The survey link was also sent to all health care practitioners society's email lists, Facebook pages, and via their Twitter accounts.

The survey items, in addition to the telerehabilitation example video and brochure, were posted in an electronic data website called REDCap (Research Electronic Data Capture). REDCap is a free and secure web-based application designed to support the collection of anonymous responses for research studies. Participants' responses were collected anonymously, so individual responses cannot be linked to participants' identities. REDCap complies with the Health Insurance Portability and Accountability Act (HIPAA) regulations. A qualifying question was asked at the first page to assure that only health care practitioners who are working in PR programs participated in this survey. The qualifying question was: are you a health care practitioner working in a PR program? Only the participants who answered 'YES' to this question were able to proceed to the survey.

***Sample size.*** Correlation coefficients can fluctuate based on sample sizes. Thus, the reliability of factors analysis depends on sample size. It is recommended to include 5-10 times as many subjects as items in the scale or at least 200 subjects, to minimize the chance of misleading of the results (Ferketich, 1991a). The overall sample size is the key factor in stability. Therefore, a factor that has four or more loadings greater than .6 can be considered as reliable regardless of the sample size. However, factors with low loadings may not be used apart from when a sample is larger than 300 (Guadagnoli & Velicer, 1988). Based on the number of items (17), the targeted number for enrollment for this study was between 85-170 participants.

For the logistic regression analysis, the sample size was estimated based on the event per variable (EPV) rule. The rule suggests a minimum of 10-20 times events

(Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996). To fit a logistic model to predict intention with five explanatory variables, we need 10 times the number of explanatory variables in the model ($5 \times 10 = 50$) to be equal or more the expected EPV. EPV from a study that investigated telehealth acceptance among health care practitioners was 68.24 (L. Liu et al., 2015). Therefore, we expect that the number of events in this study to be 68. Thus, the equation to estimate the sample size is: $10 \times 5 / .68 = 74$ subjects.

***Introducing telerehabilitation to the participants.*** The respondent's familiarity with telerehabilitation was ensured through requiring each participant to read the telerehabilitation brochure and/or watch the telerehabilitation video before proceeding to the questionnaire.

***Compensations for research participation.*** Each participant in the health care practitioners survey was given a chance to win one of three $ 30 gift cards. Participants who were interested in the draw had to leave their emails so the research team could send the electronic gift cards to the winners. All the participating emails were listed and enumerated. The research team asked an external person to pick the winners' numbers randomly.

***Statistical analysis.*** The primary goal was to examine the applicability of the TAM to identify determinants of telerehabilitation acceptance among health care practitioners working in PR. The secondary goal was to examine the determinants of the high intention to use telerehabilitation among health care practitioners. The TAM constructs were used as the foundations of a new instrument, Tele-Pulmonary

Rehabilitation Acceptance Scale (TPRAS), which is intended to measure acceptance of telerehabilitation use in PR. The statistical analysis of this study included validity assessments, dimensionality assessments, reliability assessments, and regression analysis. All the statistical analysis conducted using the SPSS 24.0.0 software. The following aims will be sought so as to achieve the intended goals of this study:

**Aim 1**: To develop the Tele-Pulmonary Rehabilitation Acceptance Scale (TPRAS) and test it for validity and reliability.

Descriptive statistics performed (univariate descriptive) to report the characteristics of the sample, to identify means and standard deviations, to identify percentage ceiling and floor effects, and to identify number of cases. Data screening included missing cases. No replacement for the missed data was used.

**Question 1:** Is the factor analysis appropriate for the collected data?

The initial step when analyzing data analysis was to determine the appropriateness of conducting factor analysis. This was examined by conducting Bartlett's test. This test is used to examine whether or not the items in the correlation matrix have equal variance. The null hypothesis was: all items have equal variance. If the test is significant at a p-value of .05, the null hypothesis will be rejected. Rejecting the null hypothesis indicates that there are correlations in the data and the data is appropriate for factor analysis. Then a Kaiser-Meyer-Olkin (KMO) test was examined to confirm the adequacy of a sample to conduct factor analysis. A value that is close to 1 on the KMO test indicates that the correlations are relatively compact and the appropriateness of conducting factor analysis. The KMO value should be above the minimum criteria of .50. Also, KMO statistics for individual variables were examined. These values should be above .50 as well. Variables with values below .5 can be considered for removal (Field, 2013).

**Question 2:** Do all items fit in a single dimension or multiple dimensions (subscales)?

Factor analysis (Principal axis factoring—PAF) was conducted to identify the factors in the data. A correlation matrix was screened to establish relations between items thus assisting in looking for significant correlations. Items with inter-item correlations that were higher or lower than the acceptable range of .30 to .70 were considered for revision and removal if they were not essential to the measurement (Netemeyer et al., 2003). Ferketich (1991) suggested that items with inter-item correlations below .30 are not sufficiently related to the latency of interest, and items with inter-item correlations of more than .70 are redundant and can be removed (Ferketich, 1991b).

Assessing dimensionality of the scale and determining the number of factors to extract, involved: 1) the Eigen values for each factor with a greater-than-one rule, and 2) the scree plot—the slope of the scree plot will be inspected. Factors under the sharp slope elbow of the plot were considered for deletion if they match the results of the eigenvalues (Netemeyer et al., 2003). Also, factors rotation was conducted to determine the appropriate number of factors to examine.

**Question 3:** Does the TPRAS show evidence of internal consistency reliability?

Reliability analysis was conducted on the subscales that resulted from the promax rotation. After running the reliability analysis, the inter-item correlation matrix, item-total statistics, and reliability, the statistics were screened for 1) proportion of items that an item correlates between .30 and .70 with other items, 2) average inter-item correlation ( > .30 and < .70), 3) corrected item-total correlation ( > .30 and < .70), and the change in alpha if an item is deleted. Cronbach's alpha is a value that indicates the overall reliability of a questionnaire. Cronbach's alpha of .70 to .80 is an acceptable value (Field, 2013).

**Aim 2:** To identify the significant demographic variables that could influence the intention to use telerehabilitation among health care practitioners. The hypotheses of the study were:

Hypotheses 1: PU's positive effect on the intention to utilize telerehabilitation among health care practitioners is significant.

Hypotheses 2: PEOU's positive effect on the intent to use telerehabilitation among health care practitioners is significant.

Hypotheses 3: PEOU's effect on PU among health care practitioners is significant.

Hypotheses 4: Working experience in PR influence on the PU among health care practitioners is significant.

Hypotheses 5: Working experience in PR influence on PEOU among health care practitioners is significant.

Hypotheses 6: Working experience in PR influence on the intention to use telerehabilitation among health care practitioners is significant.

Hypotheses 7: The type of PR program has a significant positive effect on the PU among health care practitioners.

Hypotheses 8: The type of PR program has a significant positive effect on the PEOU among health care practitioners.

Hypotheses 9: The type of PR program has a significant positive effect on the intention to use telerehabilitation among health care practitioners.

Hypotheses 10: The negative impact of Age on the PU among health care practitioners is significance.

Hypotheses 11: The negative impact of Age on the PEOU among health care practitioners is significant.

Hypotheses 12: The negative impact of Age on the intention to use telerehabilitation among health care practitioners is significant.

Multiple logistic regressions were conducted to test the relationships between variables in this study. For the proposed relationships between the variables see Figure 11. Logistic regression is used to model outcomes variables that have only two values—the occurrence or nonoccurrence of any specific event, or the presence or absence of a condition. The independent variables applied on the logistic regression were continuous, ordinal, or categorical. When there were a single dichotomous outcome and more than one independent variable, logistic regression analysis applied (Portney & Watkins, 2000). Logistic regression analysis was chosen for two reasons: 1) we cannot assume that (BI) is normally distributed, and 2) the dependent variable (BI) has only two values: intention to use or not to use telerehabilitation (Portney & Watkins, 2000).

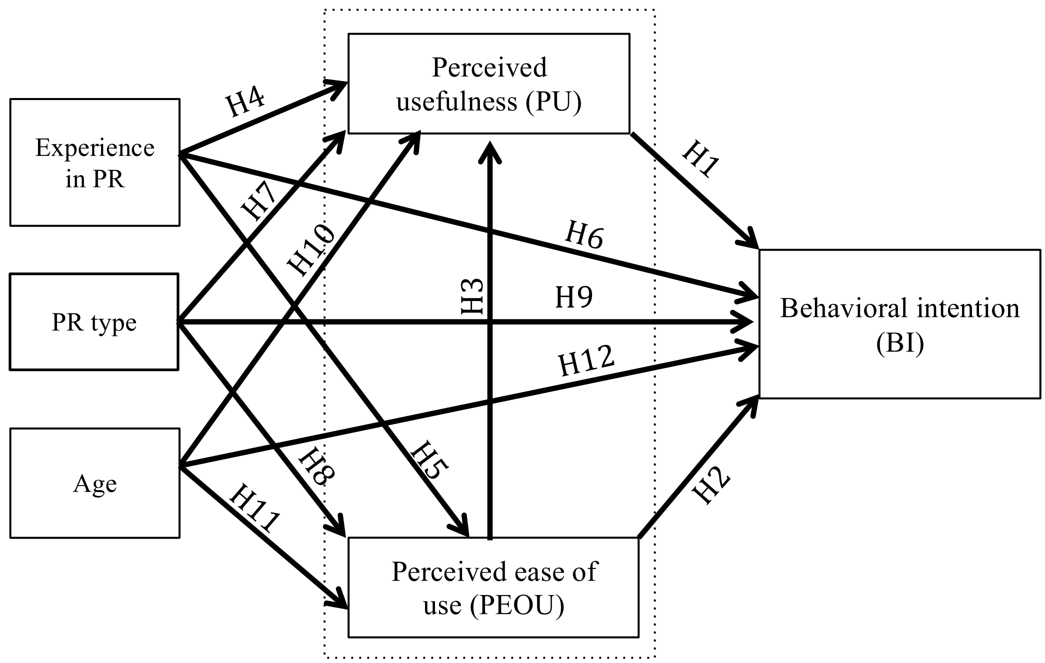


Figure 11. A model predicting health care practitioners' intention to use telerehabilitation.

**Study 2: Patients determinants of telerehabilitation acceptance.** The primary goal of our study was to examine the applicability of the TAM in predicting telerehabilitation acceptance among patients with respiratory diseases attending PR programs. The secondary objective aimed to evaluate the determinants of positive intention to use telerehabilitation among patients.

***Participants.*** The population of interest in this study were patients with respiratory conditions attending traditional PR programs. A convenience sample was recruited for participation from the PR programs within the State of Indiana, in the United States of America. The coordinators from the PR programs were asked to distribute the study's flyers to all the patients attending the programs. The flyer included information about the study's purpose and procedure. Patients who agreed to participate were asked to read the study consent form before responding to the questionnaire. Participants were considered eligible if they: 1) read and write in English, 2) are older than 18 years 3) currently attending a PR program, and 4) are having a respiratory condition. This group of participants included all the patients with respiratory conditions including patients with COPD, asthma, CF, bronchiectasis, and Kyphoscoliosis who are attending PR programs. Patients with respiratory deficiency or who underwent lung transplantation were also included in this study.

***Data collection.*** The data collection for this study was undertaken with self-administered survey. To assure that only patients with respiratory conditions who are attending PR programs were included in the study, a qualifying question was asked first. The qualifying question was: are you currently attending a PR program? Only the participants who answer 'YES' to this question were able to proceed to the questionnaire. The participants were required to either read the telerehabilitation information brochure or to watch the telerehabilitation example video before proceeding to the survey. The second qualifying question was: I watched the telerehabilitation video/ I read the telerehabilitation brochure.

Primarily, the investigator, with only one exception, conducted the data collection process. In one of the data collection sites, the data collection was conducted by a research assistant to overcome the time conflict between two differently located sites. Before the data collection, the research assistant went through training and detailed introduction to the study purpose and data collection procedures. The training of the research assistant took place in two days to make sure that the data collection procedure was consistent throughout the study.

***Sample size.*** Correlation coefficients can fluctuate based on sample sizes. Thus, the reliability of factors analysis depends on sample size. It is recommended to include 5-10 times as many subjects as items in the scale or at least 200 subjects, to minimize the chance of misleading of the results (Ferketich, 1991a). The overall sample size is the key factor in stability. Therefore, a factor that has four or more loadings greater than .6 can be considered as reliable regardless of the sample size. However, factors with low loadings may not be used apart from when a sample is larger than 300 (Guadagnoli & Velicer, 1988). Based on the number of items (13), the targeted number for enrollment for this study was between 65-130 participants.

For the logistic regression analysis, the sample size was estimated based on the event per variable (EPV) rule. The rule suggests a minimum of 10-20 times events (Peduzzi et al., 1996). To fit a logistic model to predict intention with five explanatory variables, we need 10 times the number of explanatory variables in the model ($5 \times 10 = 50$) to be equal or more the expected EPV. EPV from a study that investigated telehealth acceptance among patients was 40 (Seidman et al., 2017). Therefore, we expect that the number of events in this study to be 40. Thus, the equation to estimate the sample size is: $10 \times 5 / .4 = 125$ subjects.

***Introducing telerehabilitation to the participants.*** The respondent's familiarity with telerehabilitation was ensured through requiring each participant to read the telerehabilitation brochure and/or watch the telerehabilitation video before proceeding to the survey.

***Compensations for research participation.*** Each participant was required to read the study brochure or watch the *telerehabilitation examples* video before starting the survey. The expected average time to do the survey is nine minutes. Therefore, gift cards with a value of $10 each were offered to be given for each participant to make up for the time spent taking the survey. A gift card with a value of $10 provided no undue influence for an adult participating in this research project.

***Statistical analysis.*** The primary goal was to examine the applicability of the TAM to identify determinants of telerehabilitation acceptance among patients attending PR programs. The secondary goal was to examine the determinants of the positive intention to use telerehabilitation among patients attending PR programs. The TAM constructs were used as the foundations of a new instrument, Tele-Pulmonary Rehabilitation Acceptance Scale (TPRAS), which is intended to measure acceptance of telerehabilitation use in PR. The statistical analysis of this study included validity assessments, dimensionality assessments, reliability assessments, and regression analysis. All the statistical analysis conducted using the SPSS 24.0.0 software. The following aims will be sought so as to achieve the intended goals of this study:

**Aim 1**: To develop the Tele-Pulmonary Rehabilitation Acceptance Scale (TPRAS) and test it for validity and reliability.

Descriptive statistics performed (univariate descriptive) to report the characteristics of the sample, to identify means and standard deviations, to identify percentage ceiling and floor effects, and to identify number of cases. Data screening included missing cases. No replacement for the missed data was used.

**Question 1:** Is the factor analysis appropriate for the collected data?

The initial step when analyzing data analysis was to determine the appropriateness of conducting factor analysis. This was examined by conducting Bartlett's test. This test is used to examine whether or not the items in the correlation matrix have equal variance. The null hypothesis was: all items have equal variance. If the test is significant at a p-value of .05, the null hypothesis will be rejected. Rejecting the null hypothesis indicates that there are correlations in the data and the data is appropriate for factor analysis. Then a Kaiser-Meyer-Olkin (KMO) test was examined which aimed to demonstrate the adequacy of the sample to conduct factor analysis. A value that is close to 1 on the KMO test indicates that the correlations are relatively compact and the appropriateness of conducting factor analysis. The KMO value should be above the minimum criteria of .50. Also, KMO statistics for individual variables were examined. These values should be above .50 as well. Variables with values below .50 can be considered for removal (Field, 2013).

**Question 2:** Do all items fit in a single dimension or multiple dimensions (subscales)?

Factor analysis (Principal axis factoring—PAF) was conducted to identify the factors in the data. A correlation matrix was screened to establish relations between items thus assisting in looking for significant correlations. Items with inter-item correlations that were higher or lower than the acceptable range of .30 to .70 were considered for revision and removal if they were not essential to the measurement (Netemeyer et al., 2003). Ferketich (1991) suggested that items with inter-item correlations below .30 are not sufficiently related to the latency of interest, and items with inter-item correlations of more than .70 are redundant and can be removed (Ferketich, 1991b).

Assessing dimensionality of the scale and determining the number of factors to extract, involved: 1) the Eigenvalues for each factor with a greater-than-one rule, and 2) the scree plot—the slope of the scree plot will be inspected. Factors under the sharp slope elbow of the plot were considered for deletion if they match the results of the eigenvalues (Netemeyer et al., 2003). Also, factors rotation was conducted to determine the appropriate number of factors to examine.

**Question 3:** Does the TPRAS show evidence of internal consistency reliability?

Reliability analysis was conducted on the subscales that resulted from the promax rotation. After running the reliability analysis, the inter-item correlation matrix, item-total statistics, and reliability, the statistics were screened for 1) proportion of items that an item correlates between .30 and .70 with other items, 2) average inter-item correlation ( > .30 and < .70), 3) corrected item-total correlation ( > .30 and < .70), and the change in alpha if an item is deleted. Cronbach's alpha is a value that indicates the overall reliability of a questionnaire. Cronbach's alpha of .70 to .80 is an acceptable value (Field, 2013).

**Aim 2:** To identify the significant demographic variables that could influence the intention to use telerehabilitation among patients. The hypotheses of the study were:

Hypotheses 1: PU's positive effect on the intention to utilize telerehabilitation among patients is significant.

Hypotheses 2: PEOU's positive effect on the intent to use telerehabilitation among patients is significant.

Hypotheses 3: PEOU's effect on PU among patients is significant.

Hypotheses 4: Duration of the disease influence on the PU among patients is significant.

Hypotheses 5: Duration of the disease influence on PEOU among patients is significant.

Hypotheses 6: Duration of the disease influence on the intention to use telerehabilitation among patients is significant.

Hypotheses 7: Distance from the PR center has a significant positive effect on the PU among patients.

Hypotheses 8: Distance from the PR center has a significant positive effect on the PEOU among patients.

Hypotheses 9: Distance from the PR center has a significant positive effect on the intention to use telerehabilitation among patients.

Hypotheses 10: The negative impact of Age on the PU among patients is significance.

Hypotheses 11: The negative impact of Age on the PEOU among patients is significant.

Hypotheses 12: The negative impact of Age on the intention to use telerehabilitation among patients is significant.

Multiple logistic regressions were conducted to test the relationships between variables in this study. For the proposed relationships between the variables see Figure 12. Logistic regression is used to model outcomes variables that have only two values—the occurrence or nonoccurrence of any specific event, or the presence or absence of a condition. The independent variables applied on the logistic regression were continuous, ordinal, or categorical. When there were a single dichotomous outcome and more than one independent variable, logistic regression analysis applied (Portney & Watkins, 2000). Logistic regression analysis was chosen for two reasons: 1) we cannot assume that (BI) is normally distributed, and 2) the dependent variable (BI) has only two values: intention to use or not to use telerehabilitation (Portney & Watkins, 2000).

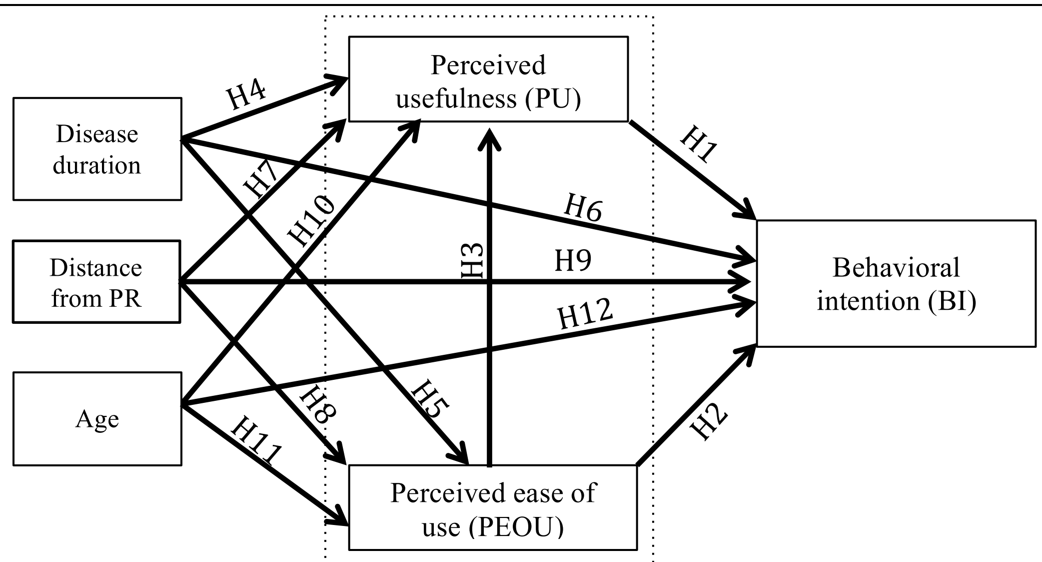


Figure 12. A model predicting patients' intentions to use telerehabilitation.

## Summary

The primary purpose of phase II of this study was to determine the main variables that can influence telerehabilitation acceptance using the TAM. This study also aimed to examine the influence of other demographic variables on the intention to use telerehabilitation among health care practitioners and patients. The study consisted of two phases. In phase I, a scale that is based on the TAM was developed. The scale development included content and face validity assessments. The outcome of phase I was used to collect data from potential users of telerehabilitation in two studies. These two studies examined the determinants of telerehabilitation acceptance among health care practitioners and patients. Also, it examined the demographic variables that might affect telerehabilitation acceptance age, working experience, duration of the respiratory disease, and the distance from PR center. The results of these studies will help to refine the design of the Tele-Pulmonary Rehabilitation Acceptance Scale (TPRAS), and to build a model, through regression analysis, that can predict telerehabilitation acceptance among potential users. The results of this study will help understanding determinants of telerehabilitation acceptance and could be used to modify the design of future telerehabilitation programs.

# Chapter IV: Results

## Overview

The goal of this study was to measure the potential factors that may influence acceptance of telerehabilitation among health care practitioners and patients. To accomplish this goal, the process started with two rounds of content validity evaluation that included nine experts, who validated the telepulmonary rehabilitation acceptance items. The final items from the content validity assessments were divided into two scales based on the experts' suggestions. One scale was intended to measure telerehabilitation acceptance among health care practitioners, and another scale was intended to measure telerehabilitation acceptance among patients. Each scale included three subscales measuring two domains, perceived usefulness (PU) and perceived ease of use (PEOU), in addition to a scale to measure the behavioral intention (BI) of both groups of the participants. To our knowledge, this is the first scale developed and used specifically to measure the acceptance of using telerehabilitation in PR programs. This also is the first study to measure telerehabilitation acceptance of both potential user groups: health care practitioners and patients.

The two scales developed in the first phase have been utilized to collect participants' responses in two studies. The first group of participants consisted of health care practitioners who were working in PR programs. The second group of the participants included patients who were attending PR programs. In each study, we first conducted a series of descriptive analyses to explore the participants' demographics. This was followed by item analysis that calculated items' means, variance, range, ceiling, floor, and item-to-total correlation. We then conducted multiple statistical analyses to examine the following: a) if the factor analysis was appropriate to be conducted for the collected data, b) to examine if all the items fit in a single dimension or multiple dimensions, and c) to test the internal consistency reliability of the scales. For each internal consistency reliability analysis, we reported Cronbach's alpha for the PU, PEOU, and BI subscales.

The second group of analyses was conducted with the aim to identify the factors influencing telerehabilitation acceptance of each group of the participants. To achieve the goal, logistic regression analysis was conducted on the collected data. The logistic regression included the TAM constructs, additional factors suggested in the literature, and supplementary factors suggested during the scale development phase. The logistic regression analysis was conducted to examine the effect of the additional factors on the TAM's predictability of the intention to use telerehabilitation. Outcomes of this analysis step will help build a model with better predictability of the intention to use telerehabilitation.

The final step of the statistical analysis aimed to examine the proposed hypotheses in each study. The goal of testing the hypothesis was to examine the relationships between PU, PEOU, age, experience in rehabilitation, and the type of PR program on health care practitioners' intention to use telerehabilitation. Also, the goal was to examine the relationships between PU, PEOU, age, diseases duration, and travel time to the PR center on patients' intention to use telerehabilitation. Series of regression analyses were conducted to examine path coefficients for each factor in the model. The first analysis was a logistic regression with BI as the dependent variable. The second and third regressions were linear regression analyses with PU and PEOU as a dependent variable in each of the linear regression analyses.

### Study 1: Health Care Practitioners' Determinants of Telerehabilitation Acceptance

This section included the results of the first study that included health care practitioners working in PR. This section starts with overview of the sample characteristics and is followed by the results of the factor analysis and the reliability analysis. This section also included the results of the model building process including the hypothesis testing results.

**Characteristics of the participants in Study 1.** This study included a sample of health care practitioners working in PR programs. The sample were health care practitioners from different health disciplines, including physicians, nurses, respiratory therapists, physiotherapists, occupational therapists, and exercise physiologists. Copies of the survey flyer, which included the survey's purpose and the link to the survey, were distributed to all IU Health PR centers. A link to the REDCap website that contained the survey was also posted on multiple discussion forums, on Facebook pages, and on Twitter accounts that belong to health care and pulmonary rehabilitation facilities. Because the survey link was distributed on the web, the responses were received from health care practitioners located in 29 different states in the United States of America and from another 20 countries across the world.

The data collection process started in January 2017 and lasted until May 2017. A total of 222 subjects completed the survey. Only 39 (19.2%) of the participants indicated that they have used telehealth or telerehabilitation. In this sample, 79 % of the health care practitioners indicated a positive intention toward using telerehabilitation in the future. Additional demographic characteristics were also collected from the sample in this study. Table 21 lists the characteristics of all health care practitioners who participated in the Tele-Pulmonary Rehabilitation Acceptance Survey. The participants in this study were offered two choices to learn about telerehabilitation before taking the survey. The majority of the participants (66.5%) read the Telerehabilitation brochure and watched the Telerehabilitation examples video.

Table 21
*Sample Characteristics of Health Care Practitioners in Study 1 (N = 222)*

| Characteristic | M | SD | Range |
|---|---|---|---|
| Age | 40.44 | 12.09 | 21-68 |
| Gender | **n** | **%** | |
| Female | 120 | 54.1 | |
| Male | 83 | 37.4 | |
| Preferred not to answer | 19 | 8.6 | |
| Location | **n** | **%** | |
| United Sates of America (U.S.A) | 102 (29 States) | 46 | |
| Out side the U.S.A | 46 (20 Countries) | 20.7 | |
| Not determined | 74 | 33 | |
| Type of the PR Program | **n** | **%** | |
| Hospital out-patient program | 109 | 58.0 | |
| Community based program | 15 | 8.0 | |
| In-patient program | 36 | 19.1 | |
| More than one type of PR | 28 | 14.9 | |
| Used Telehealth or Telerehabilitation | **n** | **%** | |
| Yes | 39 | 19.2 | |
| Health Care Profession | **n** | **%** | |
| Physician | 15 | 7.4 | |
| Nurse | 17 | 8.4 | |
| Respiratory therapist | 113 | 55.7 | |
| Physiotherapist | 30 | 14.8 | |
| Occupational therapist | 5 | 2.5 | |
| Exercise physiologist | 18 | 8.9 | |
| Other health care professional | 5 | 2.5 | |
| Experience in Health care | M | SD | Range |
| Year (s) | 16.51 | 12.18 | 1- 44 Year (s) |
| Experience in Rehabilitation Services | 8.50 | 8.81 | 1-39 years |
| Working Hours/ Week | 36.83 | 13.48 | **Mode:** 40. |

**Health care practitioners' telerehabilitation acceptance item analysis.** Items' means, variance, range, ceiling, floor, and item-to-total correlation are listed in Table 22. The practitioners' telepulmonary rehabilitation acceptance (TPRAS) item means ranged from 2.80 (Easy learn) to 3.29 (Access). There was good variability in relation to the means (SDs ranged from .63 to .79) with a range of 1–4. The highest ceiling effect was 36.9% (Access) for the TPRAS items, which indicates that 36.9% of the participants agreed with the item (Telerehabilitation will improve patients' access to rehabilitation programs). The highest floor effect was 4.5% (Communication), which indicates that 4.5% of the participants strongly disagreed with the item (Telerehabilitation will improve my communication with the patients). The item means indicated that the (Easy learn*)* item was rated the lowest by health care practitioners, and the (Access) item was rated the highest. Item-to-total correlations for the TPRAS items ranged from .51 to .80, which is very close to the normal range of .30 to .70, suggested by Ferketich (1991).

Table 22
*Descriptive Statistics for TPRAS Items (N = 222)*

| TPRAS items | M (SD) | Range | % Ceiling | % Floor | Item-to-total Correlation |
|---|---|---|---|---|---|
| Save time | 2.91 (.79) | 1- 4 | 23.4 | 3.2 | .64 |
| Access | 3.29 (.63) | 1- 4 | 36.9 | 1.4 | .69 |
| Attendance | 3.12 (.73) | 1- 4 | 31.5 | 1.8 | .73 |
| Facilitate monitoring | 2.98 (.73) | 1- 4 | 21.7 | 3.6 | .71 |
| Adherence | 2.98 (.78) | 1- 4 | 25.3 | 4.1 | .80 |
| Facilitate monitoring daily | 3.06 (.66) | 1- 4 | 21.6 | 3.2 | .70 |
| Quick care | 2.94 (.79) | 1- 4 | 24.4 | 4.1 | .75 |
| Communication | 3.04 (.74) | 1- 4 | 24.4 | 4.5 | .75 |
| Useful | 3.19 (.72) | 1- 4 | 33.0 | 4.1 | .79 |
| Easy learn | 2.80 (.66) | 1- 4 | 10.5 | 3.2 | .51 |
| Easy edu | 2.90 (.73) | 1- 4 | 18.7 | 3.2 | .55 |
| Convenient | 2.86 (.73) | 1- 4 | 16.8 | 4.1 | .62 |
| Easy to use | 2.89 (.71) | 1- 4 | 17.4 | 2.8 | .77 |

***Question 1: Is the factor analysis appropriate for the collected data?*** A principal axis factor analysis was conducted on the 13 items of the TPRAS with promax rotation. The Kaiser-Meyer-Olkin measure with a value of .92 (above the minimum criterion of .50) verified the sampling adequacy for the analysis. The Bartlett's measure test was significant ($p$ < .01), which indicated that the correlation matrix was not an identity matrix and that the data were appropriate for factor analysis (Table 23). The interitem correlation matrix showed that the item correlations were all between .30 and .75, which is above the cutoff criteria of .30 (Table 24). Items with correlations between .70 and .80 will not be deleted or modified in this stage of the scale development.

Table 23
*KMO and Bartlett's Test*

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .92 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1780.19 |
| | *df* | 78 |
| | *p* | < .01 |

Table 24
*TPRAS Inter-Item Correlation Matrix for the TPRAS Items (N = 222)*

| | Save time | Access | Attendance | Facilitate monitoring | Adherence | Facilitate monitoring daily | Quick care | Communication |
|---|---|---|---|---|---|---|---|---|
| Save time | 1.00 | .48 | .52 | .41 | .49 | .48 | .64 | .47 |
| Access | .48 | 1.00 | .64 | .49 | .63 | .44 | .50 | .57 |
| Attendance | .53 | .64 | 1.00 | .52 | .75 | .55 | .55 | .55 |
| Facilitate monitoring | .41 | .49 | .52 | 1.00 | .64 | .64 | .53 | .64 |
| Adherence | .49 | .63 | .75 | .64 | 1.00 | .59 | .60 | .64 |
| Facilitate monitoring daily | .48 | .44 | .55 | .64 | .59 | 1.00 | .61 | .60 |
| Quick care | .64 | .50 | .55 | .53 | .60 | .61 | 1.00 | .62 |
| Communication | .47 | .57 | .55 | .64 | .64 | .60 | .62 | 1.00 |
| Useful | .53 | .63 | .57 | .65 | .68 | .53 | .67 | .67 |

Determinant = .00

Table 24 (*Continued*).
*TPRAS Inter-Item Correlation Matrix for the TPRAS Items (N = 222)*

| | Easy learn | Easy edu | Convenient | Easy to use |
|---|---|---|---|---|
| Easy learn | 1.00 | .30 | .37 | .62 |
| Easy edu | .30 | 1.00 | .51 | .56 |
| Convenient | .37 | .51 | 1.00 | .61 |
| Easy to use | .62 | .56 | .61 | 1.00 |

Determinant = .00

***Question 2: Do all items fit in a single dimension or in multiple dimensions (subscales)?*** We ran an initial analysis to obtain eigenvalues for each factor in the data. As shown in Table 25, two factors had eigenvalues over Kaiser's criteria of 1. In combination, the two factors explained 63.61% of the variance. The scree plot was unclear and showed inflexions that would justify retaining either one or two factors (Figure 13). However, retaining two factors is justified based on the eigenvalue greater-than-one criteria and according to the content validity assessment, which suggested extracting two factors. Table 26 shows the factor loadings after the promax rotation. The items that loaded high on Factor 1 represent PU items, and the items that loaded high on Factor 2 represent PEOU items.

Table 25

*Total Variance Explained of The TPRAS Items*

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % |
| 1 | 7.27 | 55.90 | 55.90 | 6.86 | 52.74 | 52.74 | 4.30 | 33.02 | 33.02 |
| 2 | 1.00 | 7.71 | 63.61 | .59 | 4.51 | 57.25 | 3.15 | 24.23 | 57.25 |
| 3 | .82 | 6.33 | 69.93 | | | | | | |
| 4 | .70 | 5.39 | 75.32 | | | | | | |
| 5 | .56 | 4.28 | 79.61 | | | | | | |
| 6 | .51 | 3.92 | 83.52 | | | | | | |
| 7 | .46 | 3.56 | 87.08 | | | | | | |
| 8 | .37 | 2.84 | 89.92 | | | | | | |
| 9 | .34 | 2.64 | 92.56 | | | | | | |
| 10 | .32 | 2.43 | 94.99 | | | | | | |
| 11 | .23 | 1.79 | 96.78 | | | | | | |
| 12 | .22 | 1.68 | 98.46 | | | | | | |
| 13 | .20 | 1.54 | 100.00 | | | | | | |

Extraction Method: Principal Axis Factoring.

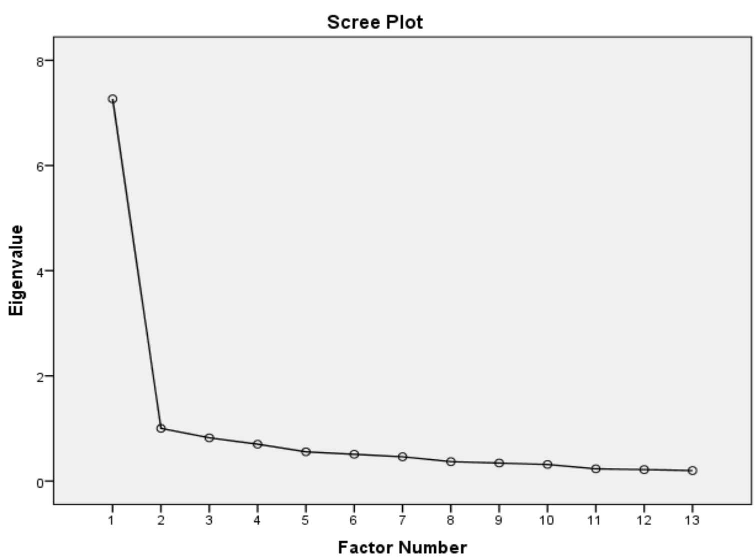


Figure 13. Scree plot of the TPRAS items eigenvalue.

Table 26
*TPRAS Items Factor Loadings After Promax Rotation (N = 222)*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| Save time | .63 | .67 |
| Access | .71 | .62 |
| Attendance | .76 | .64 |
| Facilitate monitoring | .78 | .50 |
| Adherence | .84 | .64 |
| Facilitate monitoring daily | .73 | .58 |
| Quick care | .76 | .69 |
| Communication | .78 | .65 |
| Useful | .82 | .672 |
| Easy learn | .44 | .60 |
| Easy edu | .55 | .65 |
| Convenient | .65 | .73 |
| Easy to use | .61 | .87 |

Extraction Method: Principal Axis Factoring. Rotation Method: Promax with Kaiser Normalization.

***Question 3: Does the TPRAS show evidence of internal consistency reliability?***

We performed an internal consistency reliability analysis for the subscales PU, PEOU, and BI. The internal consistency reliability for PU items was supported by a Cronbach's alpha of .92 ($N = 222$). *Cronbach's Alpha if Item Deleted* did not suggest any improvement if an item was deleted. Therefore, none of the PU items were deleted in this step. The internal consistency reliability for PEOU items was supported by a Cronbach's alpha of .80 ($N = 222$). *Cronbach's Alpha if Item Deleted* did not suggest any improvement if an item was deleted. Therefore, none of the PEOU items were deleted in this step. An internal consistency reliability analysis was conducted for the BI items. The internal consistency reliability for the BI items was supported by a Cronbach's alpha of .95 ($N = 222$). The average mean of the BI items was 3.0, and the average median was 3.0. See Table 27 for the reliability statistics for the PU, POEU, and BI subscales' items.

Table 27
*Reliability Statistics of the PU, PEOU, BI Subscale Items*

| Subscale | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|---|
| Perceived Usefulness Subscale (PU) | .92 | .93 | 9 |
| Perceived Ease of Use Subscale (PEOU) | .80 | .80 | 4 |
| Behavioral Intention Subscale (BI) | .95 | .95 | 4 |

**Health care practitioners telerehabilitation acceptance predictors' model.**

The goal of the analyses in this section was to examine the ability of the TAM constructs (PU and PEOU) to explain the variance of the intention to use telerehabilitation among health care practitioners. The TAM constructs were evaluated alone in one step. In the following steps, additional demographic variables were also included in the model to examine their effect of the percentage of variance predicted by the model. The last part of this section was designated for the hypothesis testing, which aimed to test the significance of the relationships between the TAM constructs, demographic variables and the intention to use the telerehabilitation.

***Results of the logistic regression.*** A logistic regression analysis was conducted to assess the ability of the independent variables to predict the intention of health care practitioners to use telerehabilitation. The predictor variables in this study were health care practitioners' PU, PEOU, age, length of experience in health care, length of experience in the rehabilitation field, program type, gender, health profession, working hours, and previous use of telehealth or telerehabilitation. The BI, as the dependent variable, was dichotomized to *Agree* or *Disagree* based on the participants' responses on the 4-level Likert scale. First, the average score for each item of the BI subscale was calculated. Then scores above the midpoint values of 2.5 were categorized as *positive* *intention*, while scores equal or below 2.5 were categorized as *negative intention*. The variable *PR type* was categorized into three groups for this analysis. The cases that indicated working in more than one type of PR were excluded from the analysis. The three PR types that were included in this analysis were hospital outpatient PR, community-based PR, and inpatient PR. The variable *inpatient PR* was set as a contrast variable for the other variables. The variable *health profession* was also categorized into three categories. The new categories were physician and nurse; respiratory therapist; and physiotherapist, occupational therapist, exercise physiologist, and other health professionals. The variable *physician and nurse* was set as a contrast variable for the other variables. The new categorization of the variable *health profession* reflected the nature of the health practitioners' roles in PR in each group.

Logistic regression with the blocking of variables was conducted on the data. The first block included the TAM constructs (PU and PEOU). In the second block, the variables suggested in the telehealth acceptance literature were included (age, experience in PR, and program type). Additional variables that have been suggested from the content and face validity study (Findings of the face validity assessments, p. 90) and from the telehealth acceptance literature (gender, health profession, experience in health care, working hours, and previous use of telehealth or telerehabilitation) were included in the third block in the logistic regression analysis.

Results from the logistic regression showed that the full model versus a model with intercept only was significant, chi-square ($N = 134$) = 48.42, $p < .01$. Results from the regression analysis block 1 showed that the TAM constructs (PU and PEOU) alone were good for predicting intention to use telerehabilitation compared with a model with no variables (chi-square: 48.42, $p < .01$). Pseudo R-squared statistics suggested that the model explains roughly 30%–47% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was a good fit for the data (chi-square: 12.54, $p = .13$). The only significant predictor in block 1 of the model was PU (odds ratio [*OR*]: 17.81, 95%; confidence interval [CI]: 2.88–110.27, $p < .01$). The *OR* of PU indicates that for every one unit of increase in the PU score, the odds of having positive intention to use telerehabilitation among health care practitioners will increase by 17.81 times if all other variables are constant. Table 28 shows the logistic regression coefficient, Wald test, *p* value, *OR*, and 95% CI for *OR* for each of the predictors in Block 1.

Table 28
*Logistic Regression (Block 1) Predicting BI from TAM Constructs (PU and PEOU)*

| Model | *B* | Wald | *p* | *Odds Ratio* | 95% C.I. for *OR* | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Perceived Usefulness (PU) | 2.88 | 9.59 | < **.01** | 17.81 | 2.88 | 110.20 |
| Perceived Ease of Use (PEOU) | 1.23 | 2.47 | .12 | 3.42 | .74 | 15.90 |
| Constant | -10.07 | 18.91 | < .01 | < .01 | | |

Variable(s) entered on Block 1: PU and PEOU.
Omnibus tests of model coefficients: (Chi-square= 48.42, $df = 2$, $p < .01$).
(Cox and Snell $R^2 = .30$). (Negelkerke $R^2 = .47$).

Logistic regression results showed that Block 2 included additional predictors: health care practitioners' age, experience in rehabilitation, and program type were significant (chi-square: 54.49, $p < .01$). Block 2 of the model was not improved significantly compared to Block 1 (chi-square: 6.06, $p = .20$). Pseudo R-squared statistics suggested that the model after Block 2 explains roughly 33%–52% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was a good fit for the data (chi square: 7.24, $p = .51$). The only significant predictor in the model from Block 2 was PU (*OR*: 17.64, 95%; CI: 2.60–119.85, $p < .01$). The odds for a health care practitioner to have a positive intention to use telerehabilitation is 17.64 times higher for every unit increase in PU of telerehabilitation if all other variables were constant. Table 29 shows the logistic regression coefficient, Wald test, *p* value, *OR*, and 95% CI for *OR* for each of the predictors in Block 2.

Table 29
*Logistic Regression (Block 2) Predicting BI from PU, PEOU, Age, Work Experience in Rehabilitation, and Program Type*

| Model | *B* | Wald | *p* | Odds Ratio | 95% C.I. for *OR* | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Perceived Usefulness (PU) | 2.87 | 8.62 | < **.01** | 17.64 | 2.60 | 119.85 |
| Perceived Ease of Use (PEOU) | 1.41 | 2.35 | .13 | 4.11 | .68 | 24.99 |
| Age | .02 | .48 | .49 | 1.03 | .96 | 1.10 |
| Type of the Program (contrast variable: in-patient PR). | | .64 | .73 | | | |
| Hospital out patient PR | -.62 | .64 | .42 | .54 | .12 | 2.45 |
| Community based PR | 19.28 | < .01 | 1.00 | 235192090.30 | < .01 | . |
| Experience in Rehabilitation | -.02 | .26 | .61 | .98 | .90 | 1.07 |
| Constant | -10.95 | 14.32 | < .01 | < .01 | | |

Variable(s) entered on Block 2: age, experience in rehabilitation, and type of the program.
Omnibus tests of model coefficients: (Chi-square = 54.49, $df = 6$, $p < .01$).
(Cox and Snell $R^2 = .33$). (Negelkerke $R^2 = .52$).

Logistic regression results showed that Block 3 included additional predictors of the positive intention to use telerehabilitation: health care practitioners' gender, health care experience, health profession, working hours, and previous use of telehealth or telerehabilitation were significant (chi-square: 65.58, $p < .01$). Block 3 was not significantly improved compared to Block 2 (chi-square: 11.09, $p = .09$). Pseudo R-squared statistics suggested that the model explains roughly 39%–60% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was not a good fit for the data (chi-square: 16.25, $p = .04$). In Block 3, the only significant predictor was PU (*OR* = 57.16, 95% CI: 4.46–733.21, $p < .01$). The *OR* for

PU indicates that for every one unit increase in PU of telerehabilitation among health care practitioners, the odds of having a positive intention to use telerehabilitation would increase 57.16 times after controlling for the other factors in the model. Table 30 shows the logistic regression coefficient, Wald test, *p* value, *OR*, and 95% CI for *OR* for each of the predictors included in Block 3.

Table 30
*Logistic Regression (Block 3) Predicting BI from PU, PEOU, Age, Work Experience in Rehabilitation, Program Type, Gender, Health Care Experience, Health Profession, Working Hours, and Previous Use of Telehealth or Telerehabilitation*

| Model | *B* | Wald | *p* | Odds Ratio | 95% C.I. for *OR* | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Perceived Usefulness (PU) | 4.05 | 9.66 | < **.01** | 57.16 | 4.46 | 733.21 |
| Perceived Ease of Use (PEOU) | 1.14 | 1.17 | .28 | 3.13 | .40 | 24.65 |
| Age | .13 | 2.45 | .12 | 1.13 | .97 | 3 |
| Type of the Program (contrast variable: in-patient PR). | | .03 | .99 | | | |
| Hospital outpatient PR | -.15 | .03 | .81 | .86 | .17 | 4.52 |
| Community based PR | 20.24 | < .01 | 1.00 | 613767759.60 | < .01 | . |
| Experience in Rehabilitation | .03 | .33 | .57 | 1.03 | .92 | 1.16 |
| Gender | -1.06 | 1.60 | .21 | .35 | .07 | 1.79 |
| Experience in Health Care | -.16 | 3.19 | .07 | .86 | .72 | 1.02 |
| Health Profession (contrast variable: Physician or Nurse). | | 2.71 | .26 | | | |
| Respiratory therapist | -.13 | .03 | .87 | .88 | .18 | 4.24 |
| Physiotherapist, Occupational therapist, Exercise physiologist. | -1.57 | 2.07 | .15 | .21 | .03 | 1.77 |
| Work Hours/ Week | < .01 | < .01 | .98 | 1.00 | .96 | 1.05 |
| Used Telehealth or Telerehabilitation | 1.90 | 3.18 | .08 | 6.68 | .83 | 53.88 |
| Constant | -13.92 | 8.19 | < .01 | < .01 | | |

Variable(s) entered on Block 3: gender, experience in health care, health profession, work hours/week, and use of telehealth or telerehabilitation.
Omnibus tests of model coefficients: (Chi-square = 65.58, *df* = 12, $p < .01$).
(Cox and Snell $R^2 = .39$). (Negelkerke $R^2 = .60$).

***Model building of the health care practitioners' telerehabilitation acceptance predictors.*** The goal of the logistic regression analysis was to examine the predictors of the positive intention to use telerehabilitation. Logistic regression using the (*enter)* method for adding the variables was conducted to assess the ability of the model to predict the positive intention to use telerehabilitation. The predictors included in this analysis were PU, PEOU, age, experience in rehabilitation, program type, gender, experience in health care, health profession, working hours, and previous use of telehealth or telerehabilitation. The model was significant (chi-square: 65.58, $p < .01$). Pseudo R-squared statistics suggested that the model explains roughly 39%–60% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was not a good fit for the data (chi-square: 16.25, $p = .04$). See Figure 14 for all the predictors and their significance values.

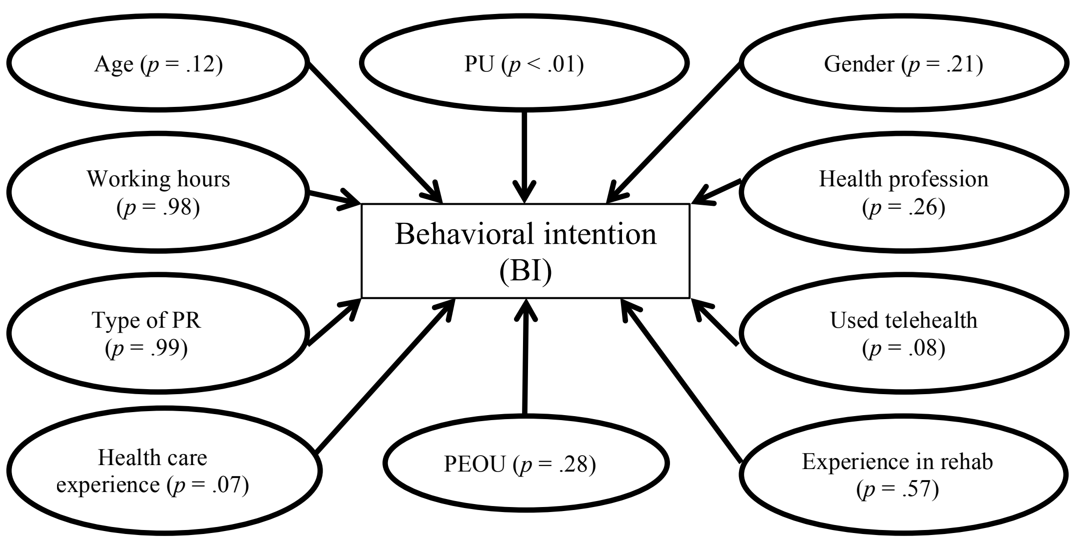


Figure 14. Health care practitioners' predictors of telerehabilitation acceptance using backward elimination *(Wald)* method.

To reduce the number of the predictors in the model, a second logistic regression analysis was conducted using the backward elimination *(Wald)* method. The removal of the variables in this method is based on the probability of the Wald statistic. All the potential variables that have been entered in the first model were also used in this analysis. The outcomes of this analysis showed that the model (Step 7) was significant (chi-square: 54.31, $p < .01$). The model included four variables: PU, age, health care experience, and previous use of telehealth or telerehabilitation. Pseudo R-squared statistics suggested that the model explains roughly 33%–52% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model (Step 7) was a good fit for the data (chi-square: 8.64, $p = .37$). See Figure 15 for all the predictors in the model and their significance values.

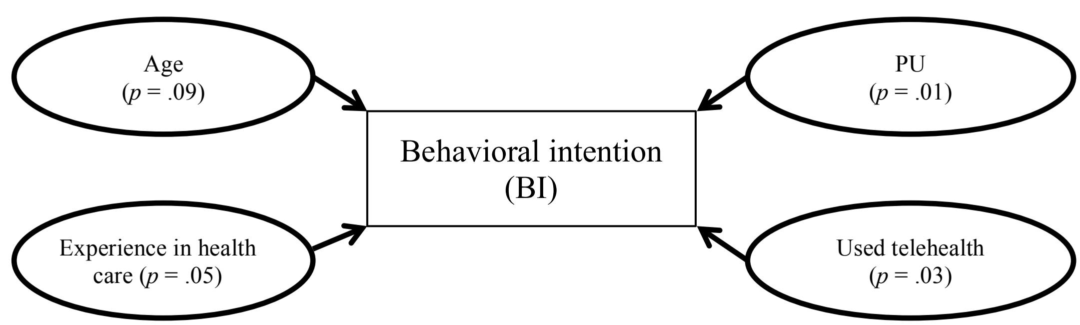


Figure 15. Health care practitioners' predictors of telerehabilitation acceptance.

***Hypothesis testing of Study 1.*** To examine the relationships between the predictors of telerehabilitation acceptance and the health care practitioners' intention to use telerehabilitation, three regression analyses were conducted. The first analysis was a logistic regression that included BI as the dependent variable while PU, PEOU, experience in rehabilitation, program type, and age were included as the predictor variables. Table 31 shows the logistic regression coefficient, Wald test, *p* value, *OR*, and 95% CI for *OR* for each of the predictors in Regression 1. According to the results of Regression 1, the following path coefficient was statistically significant: PU to BI ($\beta$ = 3.09, $p < .01$).

Table 31
*Regression (1) to Examine Relationships Between PU, PEOU, Age, Work Experience in Rehabilitation, and Program Type and BI*

| Model | | | | | 95% C.I. for *OR* | |
|---|---|---|---|---|---|---|
| | *B* | Wald | *p* | Odds Ratio | Lower | Upper |
| Perceived Usefulness (PU) | 3.09 | 10.69 | **< .01** | 22.02 | 3.45 | 140.54 |
| Perceived Ease of Use (PEOU) | 1.27 | 2.04 | .15 | 3.56 | .623 | 20.39 |
| Age | .02 | .47 | .49 | 1.02 | .957 | 1.10 |
| Program Type (contrast variable: in-patient PR). | | 1.11 | .57 | | | |
| Hospital out patient PR | -.81 | 1.11 | .29 | .45 | .100 | 2.00 |
| Community based PR | 19.13 | < .01 | 1.00 | 202276279.90 | .000 | . |
| Experience in Rehabilitation | -.02 | .26 | .61 | .98 | .891 | 1.07 |
| Constant | -11.04 | 15.21 | < .01 | < .01 | | |

Dependent Variable: BI.

To examine the relationships between PU and the predictor variables, the second analysis was a linear regression analysis that included PU as the dependent variable, while PEOU, experience in rehabilitation, program type, and age were included as the predictor variables. Table 32 shows the standardized coefficient, *t*-test, *p* value, and 95% CI of *OR* for the coefficient for each of the predictors in Regression 2. According to the results of Regression 2, the following path coefficients were statistically significant: PEOU to PU ($\beta$ = .75, $p < .01$) and outpatient PR to PU ($\beta$ = -.17, $p$ = .02).

Table 32

*Regression (2) to Examine Relationships Between PEOU, Age, Work Experience in Rehabilitation, and Program Type and PU*

| Model | Standardized Coefficients | *t* | *p* | 95.0% Confidence Interval for *B* | |
|---|---|---|---|---|---|
| | Beta | | | Lower Bound | Upper Bound |
| (Constant) | | 5.28 | < .01 | .65 | 1.43 |
| Perceived Ease of Use (PEOU) | .75 | 14.49 | **< .01** | .65 | .85 |
| Age | -.02 | -.24 | .81 | -.01 | .01 |
| Experience in Rehabilitation | .11 | 1.52 | .13 | -.00 | .02 |
| Out Patient PR | -.17 | -2.46 | **.02** | -.33 | -.04 |
| Community Based PR | -.03 | -.53 | .60 | -.33 | .18 |
| In-patient PR | -.12 | -1.77 | .08 | -.34 | .02 |

Dependent Variable: Useful.

To examine the relationships between PEOU and the predictor variables, the third analysis was a linear regression analysis that included PEOU as the dependent variable while PU, experience in rehabilitation, program type, and age were included as the predictor variables. Table 33 shows the standardized coefficient, *t*-test, *p* value, and 95% CI of *OR* for the coefficient for each of the predictors in Linear Regression 3. According to the results of Regression 3, the following path coefficients were statistically significant: PU to PEOU ($\beta$ = .74, $p$ < .01) and experience in rehabilitation to PEOU ($\beta$ = -.16, $p$ = .02).

Table 33
*Regression (3) to Examine Relationships Between PU, Age, Work Experience in Rehabilitation, and Program Type and PEOU*

| Model | Standardized Coefficients | *t* | *p* | 95.0% Confidence Interval for *B* | |
|---|---|---|---|---|---|
| | Beta | | | Lower Bound | Upper Bound |
| (Constant) | | 2.61 | .01 | .13 | .96 |
| Perceived Usefulness (PU) | .74 | 14.49 | **< .01** | .64 | .85 |
| Age | .01 | .13 | .90 | -.01 | .01 |
| Experience in Rehabilitation | -.16 | -2.34 | **.02** | -.02 | -.00 |
| Out patient PR | .10 | 1.41 | .16 | -.04 | .26 |
| Community Based PR | .05 | .85 | .40 | -.14 | .36 |
| In-Patient PR | .08 | 1.21 | .23 | -.07 | .29 |

Dependent Variable: PEOU.

The goal of testing the hypothesis was to examine the relationships between PU, PEOU, age, experience in rehabilitation, program type, and health care practitioners' intention to use telerehabilitation. The first analysis was a logistic regression where BI was set as the dependent variable, while the remaining variables were set as independent variables (Hypotheses 1, 2, 6, 9, and 12*)*. The second analysis was a linear regression. In this analysis, the PU was set as the dependent variable, while PEOU, age, experience in rehabilitation, and program type were set as independent variables (Hypotheses 3, 4, 7, and 10*)*. The final analysis was a linear regression. In this linear regression analysis, the PEOU was set as the dependent variable, while PU, age, experience in rehabilitation, and program type were set as independent variables (Hypotheses 5, 8, and 11). Based on the results of the regression analyses, the following hypotheses were tested. For the results of the path coefficient tests, see Figure 16.

Hypothesis 1 stated that PU would have a significant positive effect on the BI to use telerehabilitation. A positive path coefficient PU to BI ($\beta = 3.09$, $p < .01$) supported Hypothesis 1.

Hypothesis 2 stated that PEOU would have a significant positive effect on the BI to use telerehabilitation. A path coefficient PEOU to BI ($\beta = 1.27, p = .15$) revealed that Hypothesis 2 was not supported.

Hypothesis 3 stated that PEOU would have a significant positive effect on PU. A positive path coefficient PEOU to PU ($\beta = .75, p < .01$) revealed that Hypothesis 3 was supported.

Hypothesis 4 stated that experience in rehabilitation would have a significant positive effect on PU. The path coefficient experience during rehabilitation to PU ($\beta = .11, p = .13$) revealed that Hypothesis 4 was not supported.

Hypothesis 5 stated that experience in rehabilitation would have a significant positive effect on PEOU. A negative path coefficient experience in rehabilitation to PEOU ($\beta = -.16, p = .02$) revealed that Hypothesis 5 was not supported.

Hypothesis 6 stated that experience in rehabilitation would have a significant positive effect on the BI to use telerehabilitation. A path coefficient experience in rehabilitation to BI ($\beta = -.02, p = .61$) revealed that Hypothesis 6 was not supported.

Hypothesis 7 stated that type of the PR program would have a significant positive relationship on PU. A negative path coefficient outpatient PR to PU ($\beta = -.17, p = .02$) revealed that Hypothesis 7 was not supported.

Hypothesis 8 stated that the type of PR program would have a significant positive relationship on PEOU. Path coefficients outpatient PR, community based PR, inpatient PR to PEOU ($\beta$ = .10, .05, .08; $p$ values > .05) revealed that Hypothesis 8 was not supported.

Hypothesis 9 stated that the type of PR program would have a significant positive effect on the BI to use telerehabilitation. A path coefficient PR type to BI (Wald = 1.11, $p$ = .57) revealed that Hypothesis 9 was not supported.

Hypothesis 10 stated that age of the health care practitioner would have a significant negative effect on PU. A path coefficient age to PU ($\beta$ = -.02, $p$ = .81) revealed that Hypothesis 10 was not supported.

Hypothesis 11 stated that age of the health care practitioner would have a significant negative relationship with PEOU. A path coefficient age to PEOU ($\beta$ = .01, $p$ = .90) revealed that Hypothesis 11 was not supported.

Hypothesis 12 stated that age of the health care practitioner would have a significant negative effect on the BI to use telerehabilitation. A path coefficient age to BI ($\beta$ = .02, $p$ = .49) revealed that Hypothesis 12 was not supported.

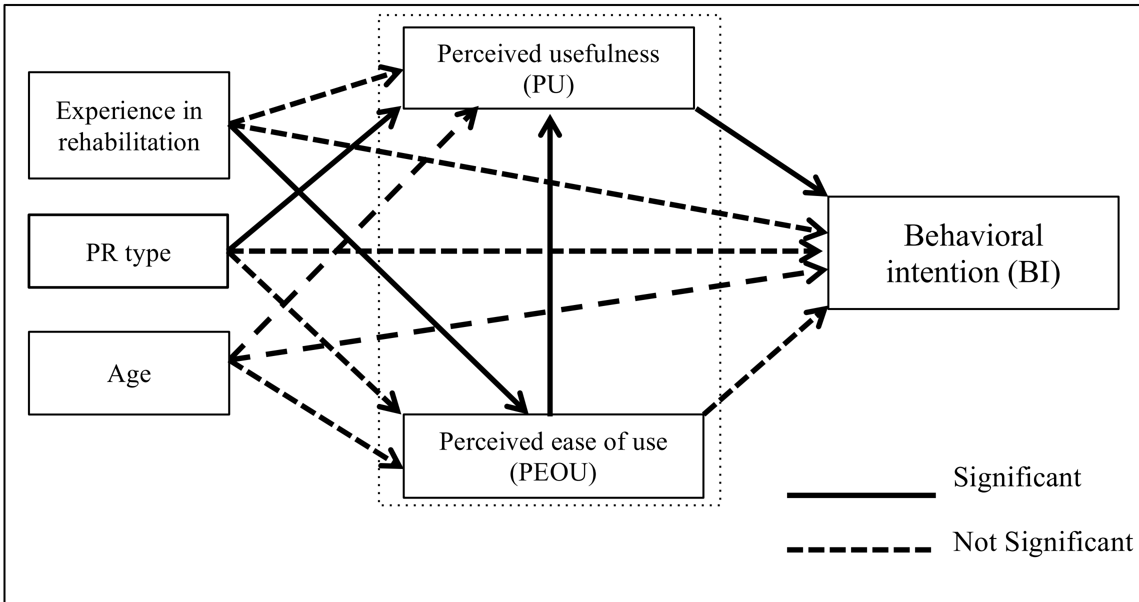


Figure 16. Path coefficients of health care practitioners' telerehabilitation acceptance model.

## Summary of the Results

The results of this study showed that factor analysis was appropriate to be conducted on the collected data based on the sample size ($N = 222$). The scale showed signs of internal consistency based on the Cronbach's alpha values. It was not clear from the results whether the scale was unidimensional or multidimensional. However, the recommendations from the content validity assessments suggested that the scale is multidimensional.

The second section of the results was to report the outcomes of the regression analyses. The logistic regression outcomes showed that additional variables—such as age, experience in rehabilitation, and PR program type—increased the predictability of the TAM to predict the intention to use telerehabilitation among health care practitioners. Additional variables—such as gender, health care experience, health profession, working hours, and previous use of telehealth or telerehabilitation—improved the predictability of the TAM as well. The logistic regression outcomes showed that PU was a significant predictor of the positive intention to use telerehabilitation among the health care practitioners. Experience in rehabilitation was negatively associated with telerehabilitation perceived ease of use among health care practitioners. Also, working in an outpatient PR program was negatively associated with the PU of telerehabilitation. The findings of this study will be discussed in the next chapter in light of the findings from other studies and the existing limitations in this study.

## Study 2: Patients' Determinants of Telerehabilitation Acceptance

This section included the results of the second study that included patients attending PR. This section starts with overview of the sample characteristics. This was followed by the results of the factor analysis and the reliability analysis. Also, this section included the results of the model building process including the hypothesis testing results.

**Characteristics of the participants in Study 2.** This study included a sample of patients with chronic respiratory diseases who are currently attending PR programs within the state of Indiana in the United States of America. A convenience sample was recruited for participation from six IU Health PR programs, the Community Hospital East PR program, and the St. Vincent Indianapolis PR program. All of these PR programs were hospital-based outpatient programs. The data collection process started in January 2017 and ran until May 2017. A total of 134 subjects from the eight PR programs completed the survey in person. None of the participants in this sample have used telehealth or telerehabilitation to receive health care services. In this sample, 61.2 % of the patients indicated a positive intention toward using telerehabilitation in the future. Additional demographic characteristics were collected from the sample in this study. Table 34 lists the characteristics of all the participants in the Tele-Pulmonary Rehabilitation Acceptance Survey. The majority of the participants in this survey had read the telerehabilitation brochure and watched the telerehabilitation examples video. Only five participants did not watch the telerehabilitation examples video before taking the survey.

Table 34
*Sample Characteristics of the Patients in Study 2 (N = 134)*

| Characteristic | M | (SD) | |
|---|---|---|---|
| Age (year) | 66.07 | 10.74 | Range: 19-87 |
| | n | % | |
| Gender | | | |
| Female | 67 | 50.4 | |
| Male | 66 | 49.6 | |
| Ethnicity | | | |
| Hispanic or Latino | 1 | .80 | |
| Not Hispanic or Latino | 123 | 99.2 | |
| Race | | | |
| American Indian or Alaskan Native | 1 | .80 | |
| Black or African-American | 19 | 14.5 | |
| Native Hawaiian or Other Pacific Islander | 1 | .80 | |
| White | 108 | 82.4 | |
| Biracial | 2 | 1.5 | |
| Level of Education | | | |
| Less than a high school degree | 6 | 4.5 | |
| High school degree or diploma | 68 | 51.5 | |
| Associate degree | 19 | 14.4 | |
| Bachelor degree | 20 | 15.2 | |
| Graduate degree | 12 | 9.1 | |
| Preferred not to answer | 7 | 5.3 | |

Table 34 (*Continued)*.
*Sample Characteristics of the Patients in Study 2 (N = 134)*

| Characteristic | n | % | |
|---|---|---|---|
| Perception of Travel Time to the Rehabilitation Center | | | |
| Less than 15 minutes | 48 | 36.4 | |
| Between 16 to 30 minutes | 70 | 53.0 | |
| Between 31 to 60 minutes | 14 | 10.6 | |
| Payment Source for the Rehabilitation Services | | | |
| Private insurance | 23 | 17.4 | |
| Out of pocket | 48 | 36.4 | |
| Medicare | 31 | 23.5 | |
| Medicaid | 6 | 4.5 | |
| VA | 2 | 1.5 | |
| Two sources of payment | 22 | 14.4 | |
| Household Income | | | |
| Income is not enough for the basic needs | 11 | 8.3 | |
| Income is just enough for the basic needs | 56 | 42.4 | |
| Financially comfortable | 38 | 28.8 | |
| Preferred not to disclose | 27 | 20.1 | |
| Types of Transportation | | | |
| Own car | 117 | 88.6 | |
| Public transportation (buses, trains, etc.) | 5 | 3.8 | |
| Taxi cab or other similar services | 2 | 1.5 | |
| Transportation offered via family friend | 8 | 6.1 | |
| Internet Access Type | | | |
| Using PCs to access the Internet | 45 | 34.1 | |
| Using Laptops to access the Internet | 55 | 41.7 | |
| Using Smartphones to access the Internet | 43 | 32.6 | |
| Using Tablets to access the Internet | 46 | 34.8 | |
| Using Smart TVs to access the Internet | 8 | 6.1 | |
| No Internet access | 29 | 22.0 | |
| Internet Experience | | | |
| Never used the Internet | 27 | 20.8 | |
| 1 to 5 years | 20 | 15.4 | |
| 6 to 10 years | 24 | 18.5 | |
| More than 10 years | 59 | 45.4 | |
| Distance of the House from the Rehabilitation Center | M | (SD) | |
| | 10.4 | 9.0 | Mode: 5.00 |
| Disease Duration (year) | 8.9 | 10.7 | Mode: 10.00 |

**Patients' telerehabilitation acceptance item analysis.** Items' means, variance, range, ceiling, floor, and item-to-total correlation are listed in Table 35. The TPRAS item means ranged from 2.92 (Easy learn) to 3.51 (Transport). There was a good variability in relation to the means (SDs ranged from .62 to .76) with a range of 1–4. For the TPRAS items, the highest ceiling effect was 57.5% (Transport), which indicates that 57.5% of the participants agreed with the item (Telerehabilitation will eliminate transportation difficulties in getting to the rehabilitation center). The highest floor effect was 1.5% (Transport, Attendance, Quick care, Communication, Useful, Easy edu, and Convenient). Items' means indicated that the (Easy learn*)* item was rated lowest by the patients, and the (Transport*)* item was rated the highest. Item-to-total correlations for the TPRAS items ranged from .58 to .82, which is very close to the normal range of .30–.70, suggested by Ferketich (1991).

Table 35
*Descriptive Statistics for TPRAS Items (N = 134)*

| TPRAS items | M (SD) | Range | % Ceiling | % Floor | Item-to-total Correlation |
|---|---|---|---|---|---|
| Access | 3.27 (.65) | 1- 4 | 35.8 | 2.2 | .71 |
| Commitment | 3.06 (.71) | 1- 4 | 26.1 | 2.2 | .76 |
| Transport | 3.51 (.63) | 1- 4 | 57.5 | 1.5 | .58 |
| Attendance | 3.12 (.76) | 1- 4 | 33.6 | 1.5 | .75 |
| Quick care | 3.20 (.73) | 1- 4 | 36.6 | 1.5 | .77 |
| Communication | 3.10 (.71) | 1- 4 | 29.1 | 1.5 | .76 |
| Useful | 3.28 (.62) | 1- 4 | 35.8 | 1.5 | .82 |
| Easy learn | 2.92 (.64) | 1- 4 | 13.1 | 3.1 | .71 |
| Easy edu | 3.05 (.63) | 1- 4 | 20.1 | 1.5 | .76 |
| Convenient | 3.22 (.65) | 1- 4 | 32.1 | 1.5 | .58 |
| Easy to use | 3.05 (.69) | 1- 4 | 23.8 | 2.3 | .75 |

***Question 1: Is the factor analysis appropriate for the collected data?*** A principal axis factor analysis was conducted on the TPRAS 11 items with promax rotation. The Kaiser-Meyer-Olkin measure with a value of .92 (above the minimum criterion of .50) verified the sampling adequacy for the analysis. The Bartlett's measure test was significant ($p < .01$), which indicated that the correlation matrix is not an identity matrix and that the data are appropriate for factor analysis (Table 36). The interitem

correlation matrix showed that the item correlations were all between .42 and .78, which is above the cut off criteria of .30 (Table 37). Items with correlations between .70 and .80 will not be deleted or modified in this stage of scale development.

Table 36
*KMO and Bartlett's Test*

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .92 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1046.26 |
| | *df* | 55 |
| | *p* | < .01 |

Table 37
*TPRAS Inter-Item Correlation Matrix for the TPRAS Items (N = 134)*

| | Access | Commitment | Transport | Attendance | Quick care | Communication | Useful |
|---|---|---|---|---|---|---|---|
| Access | 1.00 | .69 | .51 | .59 | .62 | .57 | .73 |
| Commitment | .69 | 1.00 | .44 | .65 | .59 | .67 | .69 |
| Transport | .51 | .44 | 1.00 | .52 | .49 | .42 | .58 |
| Attendance | .59 | .65 | .52 | 1.00 | .63 | .59 | .67 |
| Quick care | .62 | .59 | .49 | .63 | 1.00 | .74 | .69 |
| Communication | .57 | .67 | .42 | .59 | .74 | 1.00 | .71 |
| Useful | .73 | .68 | .58 | .67 | .69 | .71 | 1.00 |

Determinant = .00.

Table 37 (*Continued).*
*TPRAS Inter-Item Correlation Matrix for the TPRAS Items (N = 134)*

| | Easy learn | Easy edu | Convenient | Easy to use |
|---|---|---|---|---|
| Easy learn | 1.00 | .58 | .59 | .78 |
| Easy edu | .58 | 1.00 | .66 | .62 |
| Convenient | .59 | .66 | 1.00 | .74 |
| Easy to use | .78 | .63 | .74 | 1.00 |

Determinant = .00

***Question 2: Do all items fit in a single dimension or multiple dimensions (subscales)?*** We ran an initial analysis to obtain eigenvalues for each factor in the data. As a result, the analysis revealed one factor that had an eigenvalue over Kaiser's criteria of 1, which explained 63.4% of the variance (Table 38). In addition, the scree plot showed inflexions that justified retaining one factor (Figure 17).

Table 38
*Total Variance Explained of The TPRAS Items (N = 134)*

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % |
| 1 | 6.98 | 63.41 | 63.41 | 6.59 | 59.88 | 59.88 |
| 2 | .78 | 7.06 | 70.47 | | | |
| 3 | .70 | 6.32 | 76.78 | | | |
| 4 | .50 | 4.53 | 81.31 | | | |
| 5 | .43 | 3.87 | 85.18 | | | |
| 6 | .41 | 3.72 | 88.90 | | | |
| 7 | .38 | 3.44 | 92.34 | | | |
| 8 | .26 | 2.40 | 94.74 | | | |
| 9 | .23 | 2.12 | 96.86 | | | |
| 10 | .19 | 1.74 | 98.60 | | | |
| 11 | .15 | 1.40 | 100.00 | | | |

Extraction Method: Principal Axis Factoring.

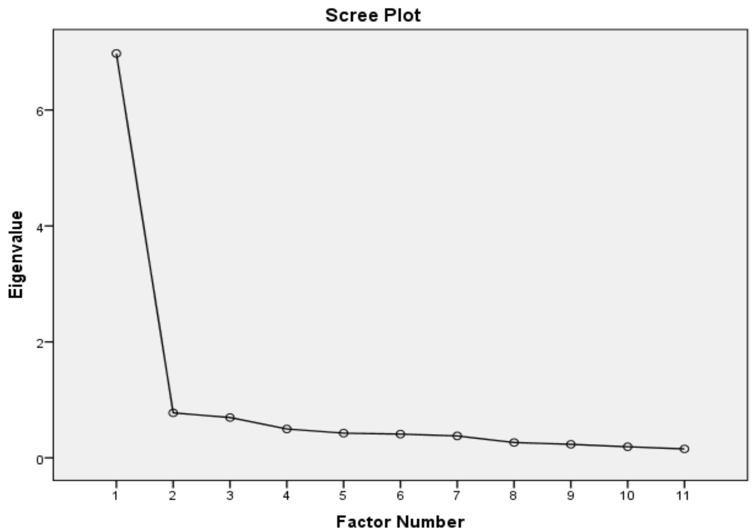


Figure 17. Scree plot of the TPRAS eigenvalue.

We conducted an exploratory factor analysis using principle axis factoring for the second time using a two-factor solution to test the applicability of the two factors in the data based on the content validity conclusion. The analysis with a predetermined eigenvalue of 2 produced better factor loadings with promax rotation. The two-factor solution explained 70.5% of the variance (Table 39). We loaded the factors with two clusters of items. Items in Factor 1 with high loadings represented PU, and items in Factor 2 with high loadings represented PEOU. See Table 40 for detailed statistics for the total variance explained by the TPRAS items.

Table 39
*Total Variance Explained of The TPRAS Items*

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % |
| 1 | 6.98 | 63.41 | 63.41 | 6.64 | 60.34 | 60.34 | 4.28 | 38.88 | 38.88 |
| 2 | .78 | 7.05 | 70.47 | .50 | 4.53 | 64.87 | 2.86 | 25.99 | 64.87 |
| 3 | .70 | 6.32 | 76.78 | | | | | | |
| 4 | .50 | 4.53 | 81.31 | | | | | | |
| 5 | .43 | 3.87 | 85.18 | | | | | | |
| 6 | .41 | 3.72 | 88.90 | | | | | | |
| 7 | .38 | 3.44 | 92.34 | | | | | | |
| 8 | .26 | 2.40 | 94.74 | | | | | | |
| 9 | .23 | 2.11 | 96.86 | | | | | | |
| 10 | .19 | 1.74 | 98.60 | | | | | | |
| 11 | .15 | 1.40 | 100.00 | | | | | | |

Extraction Method: Principal Axis Factoring.

Table 40
*TPRAS Items Factor Loadings After Promax Rotation*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| Access | .78 | .65 |
| Commitment | .80 | .62 |
| Transport | .60 | .55 |
| Attendance | .77 | .64 |
| Quick care | .81 | .60 |
| Communication | .82 | .60 |
| Useful | .88 | .72 |
| Easy learn | .62 | .81 |
| Easy edu | .75 | .68 |
| Convenient | .76 | .79 |
| Easy to use | .70 | .94 |

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.

***Question 3: Does the TPRAS show evidence of internal consistency reliability?***

We performed an internal consistency reliability analysis for the two subscales separately (PU and PEOU), as suggested by the content validity conclusion and for the BI subscale. The internal consistency reliability for PU items was supported by a Cronbach's alpha of

.91 (*N* = 134). Cronbach's Alpha if Item Deleted did not suggest any improvement if an item was deleted. Therefore, none of the PU items were deleted in this step of the process. The internal consistency reliability for PEOU items was supported by a Cronbach's alpha of .89 (*N* = 134). Cronbach's Alpha if Item Deleted did not suggest any improvement if an item was deleted. Therefore, none of the PEOU items were deleted in this step of the process. In addition, we conducted an internal consistency reliability analysis for the BI items. The internal consistency reliability for the BI items was supported by a Cronbach's alpha of .96 (*N* = 222). The means of the BI items were 2.6 and 2.7. The median was 3.0 for the two BI items. See Table 41 for the detailed reliability statistics for PU, PEOU, and BI items.

Table 41
*Reliability Statistics of the PU, POEU, BI Subscale Items*

| Subscale | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|---|
| Perceived Usefulness Subscale (PU) | .91 | .91 | 7 |
| Perceived Ease of Use Subscale (PEOU) | .89 | .89 | 4 |
| Behavioral Intention Subscale (BI) | .96 | .96 | 2 |

**Patients telerehabilitation acceptance predictors' model.**

The goal of the analyses in this section was to examine the ability of the TAM constructs (PU and PEOU) to explain the variance of the intention to use telerehabilitation among patients attending PR programs. The TAM constructs were evaluated alone in one step. In the following steps, additional demographic variables were also included in the model to examine their effect of the percentage of variance explained by the model. The last part of this section was designated for the hypothesis testing, which aimed to test the significance of the relationships between the TAM constructs, demographic variables and the intention to use telerehabilitation.

***Results of the logistic regression.*** We conducted a logistic regression analysis to assess the ability of the independent variables to predict the patients' intention to use telerehabilitation. The predictor variables in this study were patients' PU, PEOU, age, disease duration, distance from the PR center/travel time to the PR center, Internet experience, education level, household income, and PR services payment type. We dichotomized the BI, as the dependent variable, to *Agree* or *Disagree* based on the participants' responses on the four-level Likert scale. First, we calculated the average score for each item of the BI scale. Then, we categorized the scores above the midpoint value of 2.5 as *positive intention* and the scores equal to or below 2.5 as *negative intention*. The participants' responses on the distance from the PR question had many missed entries. Therefore, we replaced the variable (*distance from the PR center*), for the model building process, with a similar variable (*travel time to the PR center*), which was collected simultaneously from the participants. In this analysis, we categorized the variable travel time to the PR center into two subcategories: less than 15 minutes and between 16 and 60 minutes. Also, we categorized the variable *level of education* into two subcategories: high school or less and associate, bachelor or graduate degree. Moreover, we categorized the variable *Internet experience* into three subcategories: never used the Internet, 1 to 5 years, and more than 5 years. We also categorized the variable *type of transportation* to the PR center into two subgroups: own car and public transportation, taxi, or by a family member or a friend.

We conducted a logistic regression analysis with blocking of variables on the data. The first block included the TAM constructs (PU and PEOU). In the second block, we included the additional variables suggested in the telehealth acceptance literature (age, disease duration, and travel time to the PR center). We included additional variables that have been suggested from the content and face validity study (Findings of the face validity assessments, p. 90) and from the telehealth acceptance literature (experience of using the Internet, education level, type of transportation to the PR center, household income, and PR services payment type) in the third block in the logistic regression analysis.

Results of the logistic regression showed that the full model versus a model with intercept only was significant, chi-square ($N = 70$) = 13.54, $p < .01$. Pseudo R-squared statistics suggested that the model explains roughly 18%–24% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was a good fit for the data (chi square: 6.80, $p = .56$). The only significant predictor in Block 1 of the model was PU (*OR*: 6.46, 95% CI: 1.08–38.63, $p = .04$). The *OR* of PU indicated that for every one unit increase in the PU score, the odds of having positive intention to use telerehabilitation among patients will increase by 6.46 times, if all other variables are constant. The PEOU predictor was not significant in Block 1 (*OR*: 1.60, 95% CI: .31–8.12, $p = .57$). Table 42 shows the logistic regression coefficient, Wald test, $p$ value, *OR*, and 95% CI for each of the predictors in Block 1.

Table 42

*Logistic Regression (Block 1) Predicting BI from TAM Constructs (PU and PEOU)*

| Model | *B* | Wald | *p* | Odds Ratio | 95% C.I. for *OR* | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Perceived Usefulness (PU) | 1.87 | 4.18 | **.04** | 6.46 | 1.08 | 38.63 |
| Perceived Ease of Use (PEOU) | .47 | .32 | .57 | 1.60 | .31 | 8.12 |
| Constant | -6.93 | 7.68 | < .01 | < .01 | | |

Variable(s) entered on Block 1: PU, PEOU.
Omnibus tests of model coefficients: (Chi-square = 13.54, $df = 2$, $p < .01$).
Cox and Snell $R^2 = .18$. Negelkerke $R^2 = .24$.

Logistic regression results showed that Block 2, which included the additional predictors patients' age, disease duration, and travel time to the PR center, was significant (chi-square: 17.23, $p < .01$). Block 2 of the model was not improved significantly compared to Block 1 (chi-square: 3.70, $df = 3$, $p = .30$). Pseudo R-squared statistics suggested that the model after Block 2 explains roughly 22%–30% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was a good fit for the data (chi square: 5.50, $p = .70$). The predictor PU in Block 2 was not significant (*OR*: 5.58, 95% CI: .96–32.41, $p = .06$). The odds for a patient to have a positive intention to use telerehabilitation are 5.58 times for every unit increase in PU of telerehabilitation, if all other variables are constant. Table 43 shows the logistic regression coefficient, Wald test, *p* value, *OR*, and 95% CI for each of the predictors in Block 2.

Table 43

*Logistic Regression (Block 2) Predicting BI from PU, PEOU, Age, Duration of the Disease, and travel time to the PR center*

| Model | *B* | Wald | *p* | Odds Ratio | 95% C.I. for *OR* | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Perceived Usefulness (PU) | 1.72 | 3.67 | .06 | 5.58 | .96 | 32.41 |
| Perceived Ease of Use (PEOU) | .82 | .92 | .34 | 2.28 | .42 | 12.33 |
| Age | .04 | 2.14 | .14 | 1.04 | .99 | 1.11 |
| Duration of the Disease | .06 | 1.52 | .22 | 1.06 | .97 | 1.16 |
| Travel Time to the PR Center: Less than 15 minutes (contrast variable: between 16 to 60 minutes) | .41 | .48 | .49 | 1.51 | .47 | 4.82 |
| Constant | -11.42 | 8.92 | < .01 | < .01 | | |

Variable(s) entered on Block 2: age, duration of the disease, and travel time to the PR center.
Omnibus tests of model coefficients: (Chi-square= 17.23, *df* = 5, $p < .01$).
Cox and Snell $R^2 = .22$. Negelkerke $R^2 = .30$.

Logistic regression results showed that Block 3, which included the additional predictors experience of using the Internet, education level, type of transportation to the PR center, household income, and PR services payment type, was significant (*df* = 14, chi-square: 29.21, $p = .01$). Block 3 did not show significant improvement compared to Block 2 (*df* = 9, chi-square: 11.98, $p = .21$). Pseudo R-squared statistics suggested that the model explains roughly 34%–47% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was a good fit for the data (chi-square: 7.47, $p = .49$). In Block 3, the following predictors were significant: PU (*OR*: 9.34, 95% CI: 1.04–83.86, $p = .05$), age (*OR*: 1.09, 95% CI: 1.00–1.19, $p = .05$), and Internet experience (Wald = 5.82, *df* = 2, $p = .05$). The odds for a patient to have a positive intention to use telerehabilitation are 9.34 times for every unit increase in PU of telerehabilitation, if all other variables are constant. The odds for a patient to have a positive intention to use telerehabilitation are 1.09 times for every 1-year increase in the patient's age, if all other variables are constant. Also, the *OR* for the variable *Internet* *experience* showed that having more experience with the Internet increased the odds of having positive intention to use telerehabilitation, if all other variables were constant. Table 44 shows the logistic regression coefficient, Wald test, *p* value, *OR*, and 95% CI for each of the predictors included in Block 3.

Table 44

*Logistic Regression (Block 3) Predicting BI from PU, PEOU, Age, Duration of the Disease, Travel Time to the PR Center, Experience of Using the Internet, Level of Education, Type of Transportation to the PR Center, Household Income, and PR Services Payment Type*

| Model | *B* | Wald | *p* | Odds Ratio | 95% C.I. for *OR* | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Perceived Usefulness (PU) | 2.23 | 3.98 | **.05** | 9.34 | 1.04 | 83.86 |
| Perceived Ease of Use (PEOU) | .50 | .23 | .63 | 1.66 | .21 | 12.79 |
| Age | .08 | 3.80 | **.05** | 1.09 | 1.00 | 1.19 |
| Duration of the Disease (years) | .05 | .99 | .32 | 1.06 | .95 | 1.18 |
| Travel Time to the PR Center: Less than 15 minutes (contrast variable: between 16 to 60 minutes) | .95 | 1.64 | .20 | 2.59 | .61 | 11.11 |
| Level of Education: high school or less level of education (contrast variable: associate, bachelor, or graduate degree) | -.26 | .10 | .75 | .77 | .16 | 3.77 |
| Household Income (contrast variable: income not enough for basic needs) | | 2.64 | .27 | | | |
| Just enough for the basic needs | 1.09 | .46 | .50 | 2.97 | .13 | 69.41 |
| Financially comfortable | -.24 | .02 | .88 | .79 | .04 | 17.98 |
| Internet Experience (contrast variable: never used the Internet) | | 5.82 | **.05** | | | |
| 1 to 5 years | -1.23 | 1.06 | .30 | .29 | .03 | 3.02 |
| More than 5 years | 1.47 | 2.00 | .16 | 4.33 | .57 | 33.03 |
| Payment Type for the PR Services (contrast variable: private insurance) | | .80 | .85 | | | |
| Out of pocket | -.71 | .67 | .41 | .49 | .09 | 2.70 |
| Medicare | -.88 | .63 | .43 | .42 | .05 | 3.60 |
| Medicaid | 18.53 | < .01 | 1.00 | 111723513.30 | < .01 | . |
| Type of Transportation to the PR Center: Own car (contrast variable: Public trans, Taxi, or by a family or a friend) | .64 | .14 | .70 | 1.90 | .07 | 51.74 |
| Constant | -16.66 | 9.27 | < .01 | < .01 | | |

Variable(s) entered on Block 3: experience of using the Internet, level of education, type of transportation to the PR center, household income, and payment type for the PR services.
Omnibus tests of model coefficients: (Chi-square = 29.21, *df* =14, $p$ = .01).
Cox and Snell $R^2$ = .35. Negelkerke $R^2$ = .47.

***Model building of the patients' telerehabilitation acceptance predictors.*** The goal of the logistic regression analysis was to examine the predictors of the positive intention to use telerehabilitation. We conducted a logistic regression analysis using the (*enter)* method for adding the variables to assess the ability of the model to predict the positive intention to use telerehabilitation. The predictors included in this analysis were PU, PEOU, age, disease duration, travel time to the PR center, experience of using the Internet, education level, type of transportation to the PR center, household income, and PR services payment type. The model was significant (chi-square: 29.21, $p$ = .01). Pseudo R-squared statistics suggested that the model explains roughly 34%–47% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model was a good fit for the data (chi-square: 7.47, $p$ = .49). See Figure 18 for all the predictors and their significance values.

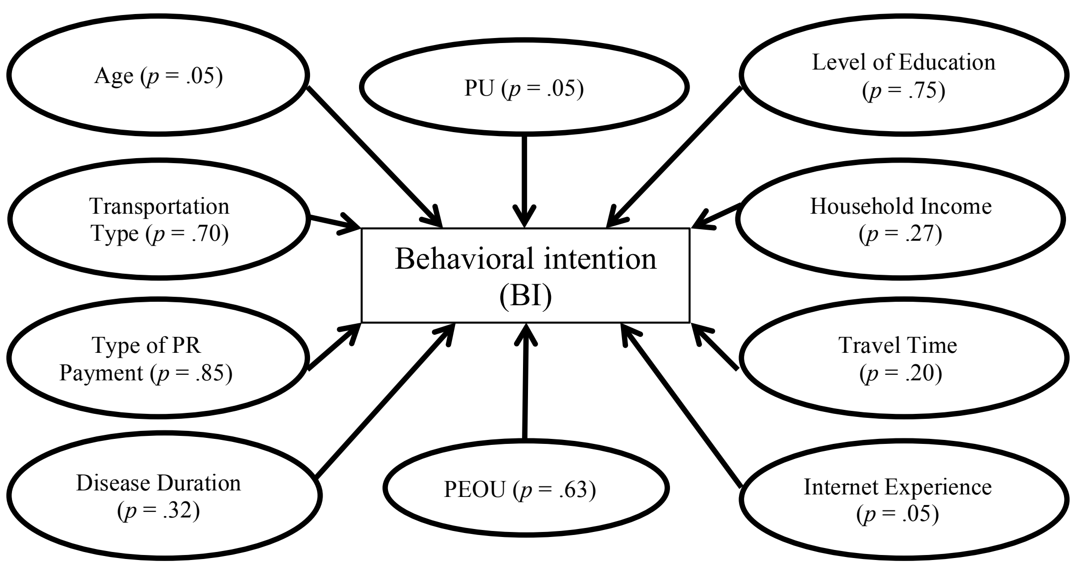


Figure 18. Patients' predictors of telerehabilitation acceptance using backward elimination *(Wald)* method.

To reduce the number of predictors in the model, we conducted a second logistic regression analysis using the backward elimination *(Wald)* method. The removal of the variables in this method is based on the probability of the Wald statistic. We used all the potential variables that we had entered in the first model in this analysis as well. The outcomes of this analysis showed that the model (Step 9) was significant (chi-square: 18.63, $p < .01$). The model included two variables: PU and experience of using the Internet. Pseudo R-squared statistics suggested that the model explains roughly 23%–32% of the variation in the outcome. The Hosmer and Lemeshow goodness-of-fit test suggested that the model (Step 9) was a good fit for the data (chi-square: 3.42, $p = .84$). See Figure 19 for all the predictors in the model and their significance values.

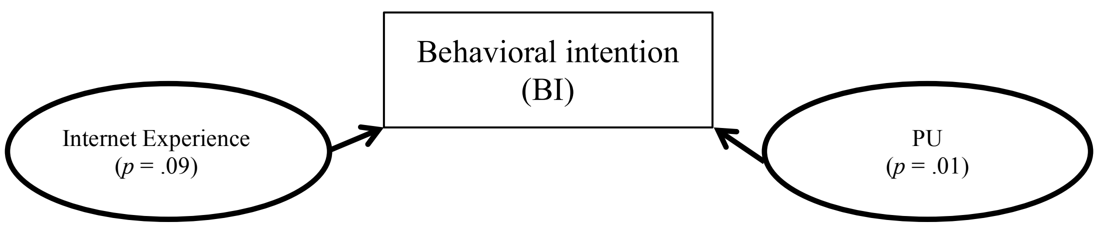


Figure 19. Patients' predictors of telerehabilitation acceptance.

***Hypothesis testing of Study 2.*** To examine the relationships between the telerehabilitation acceptance predictors and the patients' BI to use telerehabilitation, we conducted three regression analyses. The first logistic regression analysis included BI as the dependent variable, and we included PU, PEOU, age, disease duration, and distance from the PR center as the predictor variables. Table 45 shows the logistic regression coefficient, Wald test, *p* value, *OR*, and 95% CI for each of the predictors in Regression

1. According to the results of Regression 1, the following path coefficient was statistically significant: PU to BI ($\beta$ = 1.88, $p$ = .01).

Table 45
*Regression (1) to Examine Relationships Between PU, PEOU, Age, Duration of the Disease, and Distance from the PR Center and BI*

| Model | *B* | Wald | *p* | Odds ratio | 95% C.I. for *OR* Lower | Upper |
|---|---|---|---|---|---|---|
| Perceived Usefulness (PU) | 1.88 | 6.43 | **.01** | 6.57 | 1.53 | 28.12 |
| Perceived Ease of Use (PEOU) | .89 | 1.61 | .20 | 2.44 | .62 | 9.66 |
| Age | .02 | .75 | .39 | 1.02 | .98 | 1.06 |
| Duration of the Disease | < -.01 | .02 | .89 | 1.00 | .96 | 1.04 |
| Distance from the PR Center | -.01 | .23 | .63 | .99 | .94 | 1.04 |
| Constant | -9.26 | 12.11 | < .01 | < .01 | | |

Variable(s) entered on regression 1: PU, PEOU, age, duration of the disease, and distance from the PR center.

To examine the relationships between PU and the predictor variables, the second linear regression analysis included PU as the dependent variable, and we included PEOU, age, disease duration, and distance from the PR center as the predictor variables. Table 46 shows the standardized coefficient, *t*-test, *p* value, and 95% CI of *OR* for the coefficient for each of the predictors in Linear Regression 2. According to the results of Regression 2, the following path coefficient was statistically significant: PEOU to PU ($\beta$ = .82, $p$ < .01).

Table 46
*Regression (2) to Examine Relationships Between PEOU, Age, Duration of the Disease, and Distance from the PR Center and PU*

| Model | Standardized Coefficients Beta | *t* | *p* | 95.0% Confidence Interval for *B* Lower Bound | Upper Bound |
|---|---|---|---|---|---|
| (Constant) | | 1.72 | .09 | -.08 | 1.11 |
| Perceived Ease of Use (PEOU) | .82 | 14.29 | **< .01** | .70 | .93 |
| Age | .06 | .95 | .34 | < -.01 | .01 |
| Duration of the Disease | -.02 | -.37 | .71 | -.01 | .01 |
| Distance from the PR Center | .02 | .35 | .73 | -.01 | .01 |

Dependent Variable: PU.

To examine the relationships between PEOU and the predictor variables, the third linear regression analysis included PU, age, disease duration, and distance from the PR center as the predictor variables. Table 47 shows the standardized coefficient, *t*-test, *p* value, and 95% CI of *OR* for the coefficient for each of the predictors in Linear Regression 3. According to the results of Regression 3, the following path coefficients were statistically significant: PU to PEOU ($\beta$ = .79, $p$ < .01) and age to PEOU ($\beta$ = -.12, $p$ = .03).

Table 47
*Regression (3) to Examine Relationships Between PU, Age, Duration of the Disease, and Distance from the PR Center and PEOU*

| Model | Standardized Coefficients | *t* | *p* | 95.0% Confidence Interval for *B* | |
|---|---|---|---|---|---|
| | Beta | | | Lower Bound | Upper Bound |
| (Constant) | | 3.35 | < .01 | .39 | 1.53 |
| Perceived Usefulness (PU) | .79 | 14.29 | **< .01** | .68 | .90 |
| Age | -.12 | -2.19 | **.03** | -.01 | < -.01 |
| Duration of the Disease | -.02 | -.29 | .77 | -.02 | .01 |
| Distance from the PR Center | < -.01 | -.08 | .94 | -.02 | .01 |

Dependent Variable: PEOU.

The goal of the hypothesis testing was to examine the influence of PU, PEOU, age, disease duration, and distance from the PR center on patients' intention to use telerehabilitation. The first analysis was a logistic regression in which we set BI as the dependent variable and the remaining variables as independent variables (Hypotheses 1, 2, 6, 9, and 12). The second analysis was a linear regression. In this analysis, we set PU as the dependent variable and set PEOU, age, disease duration, and distance from the PR center as independent variables (Hypotheses 3, 4, 7, and 10). The final analysis was a linear regression. In this linear regression analysis, we set PEOU as the dependent variable and set PU, age, disease duration, and distance from the PR center as independent variables (Hypotheses 5, 8, and 11). Based on the results of the regression analyses, we tested the following hypotheses. For the results of the path coefficient tests, see Figure 20.

Hypothesis 1 stated that PU would have a significant positive effect on the BI to use telerehabilitation. The positive path coefficient PU to BI ($\beta = 1.88, p < .01$) supported Hypothesis 1.

Hypothesis 2 stated that PEOU would have a significant positive effect on the BI to use telerehabilitation. The path coefficient PEOU to BI ($\beta = .89, p = .20$) revealed that Hypothesis 2 was not supported.

Hypothesis 3 stated that PEOU would have a significant positive effect on the PU. The positive path coefficient PEOU to PU ($\beta = .82, p < .01$) revealed that Hypothesis 3 was supported.

Hypothesis 4 stated that duration of the disease would have a significant positive effect on the PU. The path coefficient duration of the disease to PU ($\beta = -.02, p = .71$) revealed that Hypothesis 4 was not supported.

Hypothesis 5 stated that duration of the disease would have a significant positive effect on the PEOU. The path coefficient duration of the disease to PEOU ($\beta = -.02, p = .77$) revealed that Hypothesis 5 was not supported.

Hypothesis 6 stated that duration of the disease would have a significant positive effect on the BI to use telerehabilitation. The path coefficient duration of the disease to BI ($\beta < -.01, p = .89$) revealed that Hypothesis 6 was not supported.

Hypothesis 7 stated that distance from the PR center would have a significant positive relationship on the PU. The path coefficient distance from the PR center to PU ($\beta$ = .02, $p$ = .73) revealed that Hypothesis 7 was not supported.

Hypothesis 8 stated that distance from the PR center would have a significant positive relationship on the PEOU. The path coefficient distance from the PR center to PEOU ($\beta$ < -.01, $p$ = .94) revealed that Hypothesis 8 was not supported.

Hypothesis 9 stated that distance from the PR center would have a significant positive effect on the BI to use telerehabilitation. The path coefficient distance from the PR center to BI ($\beta$ = -.01, $p$ = .63) revealed that Hypothesis 9 was not supported.

Hypothesis 10 stated that age of the patient would have a significant negative effect on the PU. The path coefficient age to PU ($\beta$ = .06, $p$ = .34) revealed that Hypothesis 10 was not supported.

Hypothesis 11 stated that age of the patient would have a significant negative relationship on the PEOU. The negative path coefficient age to PEOU ($\beta$ = -.12, $p$ = .03) revealed that Hypothesis 11 was supported.

Hypothesis 12 stated that age of the patient would have a significant negative effect on the BI to use telerehabilitation. The path coefficient age to BI ($\beta$ = .02, $p$ = .39) revealed that Hypothesis 12 was not supported.

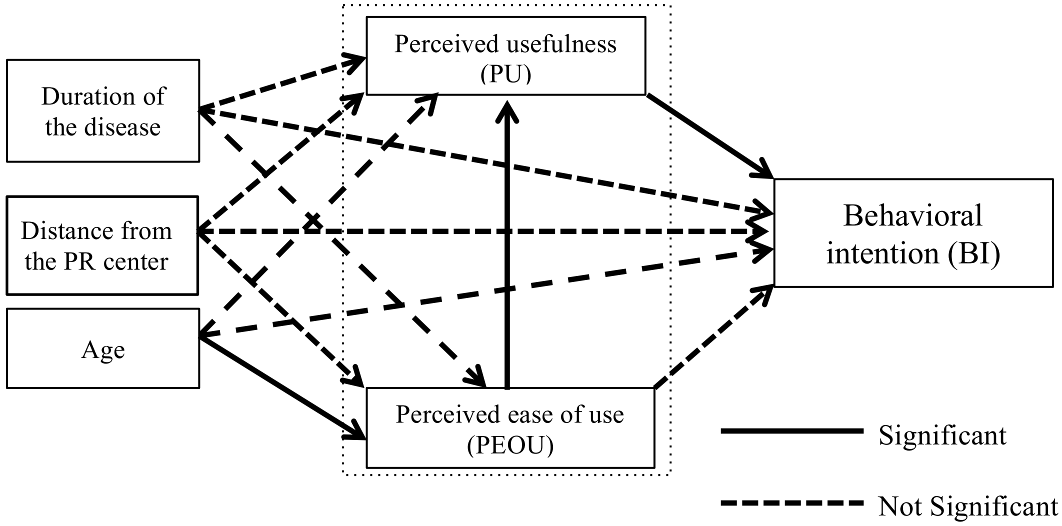

Figure 20. Path coefficients of patients' telerehabilitation acceptance model.

**Summary of the Results**

The results of this study showed that factor analysis was appropriate to conduct on the data based on the sample size ($N = 134$). The scale showed signs of validity and internal consistency based on the Cronbach's alpha values. It was not clear from the results whether the scale was unidimensional or multidimensional. However, the recommendations from the content validity assessments suggested that the scale is multidimensional.

In the second section of the results, we reported the outcomes of the regression analyses. The logistic regression outcomes showed that additional variables age, disease duration, and travel time to the PR center did not improve the predictability of the TAM significantly. Adding additional variables such as the Internet experience, level of education, type of transportation to the PR center, household income, and PR services payment type improved the predictability of the TAM to 47% of the variance. The logistic regression outcomes in this study showed that PU was a significant predictor of the positive intention to use telerehabilitation among the patients. In addition, age was negatively associated with high PEOU of telerehabilitation.

**Summary**

In this chapter, we reported the outcomes of the two studies that measured acceptance of telerehabilitation among health care practitioners and patients. The sections on the results of each study started with a report of the descriptive statistics of the sample. That was followed by the results of the item analyses for the items, including an examination of the appropriateness of conducting factor analysis, dimensionality, and internal consistency reliability results. This was followed by the results of multiple regression analyses and a path analysis aimed to test the proposed hypotheses in the two studies.

The results from the two studies showed that factor analysis was appropriate to conduct based on the sample size, and both scales showed signs of internal consistency based on the Cronbach's alpha values. The second section of the results included a report of the outcomes of the regression analyses. The logistic regression outcomes showed that additional variables age, experience in rehabilitation, and PR program type increased the power of the TAM to predict the intention to use telerehabilitation among health care practitioners. Moreover, additional variables gender, health care experience, health profession, working hours, and previous use of telehealth or telerehabilitation improved the predictability of the TAM as well. Also, the logistic regression outcomes showed that additional variables age, duration of the disease, and distance from the PR center increased the power of the TAM to predict the intention to use telerehabilitation among the patients. Moreover, additional variables such as experience of using the Internet, education level, type of transportation to the PR center, household income, and PR services payment type improved the predictability of the TAM as well.

In the next chapter, we will discuss the results of the two studies, including item analyses, dimensionality, reliability, and the regression analyses, in comparison with the findings from other studies in the literature. The next chapter will also include detailed discussions of the findings of the hypotheses testing. Last, we will conclude the chapter by discussing all the limitations in these two studies and some suggestions for future studies.

# Chapter V: Discussion

Telehealth is a growing field of practice, especially over the last two decades (Brewster et al., 2014; Cimperman, Makovec Brenčič, & Trkman, 2016). In tandem with the growth of telehealth, there is an increasing interest in the rehabilitation field in using telehealth and in switching to what is called *telerehabilitation* (Rogante et al., 2010). Most published studies in the telehealth field focus only on the feasibility and outcomes of telehealth programs, which gives an incomplete picture about the potential users' acceptance of telehealth (Hu et al., 1999; V. A. Wade et al., 2014). Understanding potential users' intentions to use telerehabilitation is a key factor in establishing successful and prolonged implementation (Asaro et al., 2004). Identifying the determinants of telerehabilitation acceptance is an essential step toward implementation. Determining what might affect telerehabilitation acceptance will help to predict future adoption and also develop appropriate solutions to address the potential barriers of telerehabilitation. To fully understand users' intentions to use telerehabilitation, acceptance must be explored with a population-specific scale that measures the multiple domains of telerehabilitation acceptance.

The goal of this study was to examine the main variables that affect the intention to use telerehabilitation among PR users. The process has been conducted in two phases that includes three studies. The first phase was a scale development study. The scale development study resulted in two scales designed to measure telerehabilitation acceptance of health care practitioners and patients attending PR programs. The scales were then used in the process of phase II in concurrent studies, which collected data from two samples of PR users. The data analyses of the two studies show that the scales had evidence of validity and reliability. The outcomes of the two studies also demonstrated that perceived usefulness of telerehabilitation was a significant predictor for positive intention to use telerehabilitation among health care practitioners and patients.

This is the first study to develop and validate psychometric instruments to measure telerehabilitation acceptance among health care practitioners working in PR programs and patients attending PR programs. The outcomes of our study will help understand the acceptance of telerehabilitation by identifying the main factors affecting the intention to use telerehabilitation and the demographics characteristic of the potential users of telerehabilitation. Furthermore, the predictors of positive intention to use telerehabilitation examined in our study will help with designing future telerehabilitation programs to meet health care practitioners and patients needs.

Telehealth and telerehabilitation acceptance was measured in multiple studies (Burkow et al., 2013; Anne E. Holland et al., 2013; Zanaboni et al., 2013), which provided inconclusive conclusions with limited generalizability. The telehealth acceptance measurement scales utilized in the reviewed studies were designed to measure telehealth acceptance of specific telehealth models and lacked theoretical frameworks that could explain the relationships between the acceptance determinants and the intention to use telehealth (Almojaibel, 2016). Exploring acceptance using theory-based scales is preferred because they have the advantage to offer generalizable conclusions about telehealth acceptance (Mair et al., 2008). Quantitative studies have also measured telehealth acceptance among health care practitioners (Gagnon et al., 2012; Hu et al., 1999; Kowitlawakul, 2011; Rho et al., 2014; Zailani et al., 2014) and patients with chronic respiratory diseases (J. P. Chau et al., 2012; J. Finkelstein et al., 1998; Nikander et al., 2010). Studies that explored telehealth acceptance included different telehealth technologies. The definitions of telehealth varied from one study to another, but most of the studies defined *telehealth* as the general use of the Internet by health care practitioners to monitor patients' vital signs and exercise data. Our study explored a new field of using telehealth, which includes using telehealth in pulmonary rehabilitation programs.

The literature includes one article similar to our research study. Liu et al. (2015) utilized the unified theory of acceptance and use of technology (UTAUT) to examine additional theoretical factors that affect acceptance of new technologies for rehabilitation by therapists (L. Liu et al., 2015). Liu and colleagues did not report the process of the content validity of the scale items. The telerehabilitation system in Liu et al.'s study was defined as the utilization of modern technologies in health care settings, which includes mechanical and computer systems used by therapists to improve patients' functions. The scope of telerehabilitation in the study by Liu et al. was different than that of the telerehabilitation practice of interest in our study, which focused on the use of telecommunication technologies to provide and receive rehabilitation services for patients at home. Also, Liu and colleagues measured only the health care practitioners' acceptance of telerehabilitation. In our study we measured telerehabilitation acceptance of both patients and health care practitioners, which provided better understanding of telerehabilitation acceptance.

A recent study explored the technology engagement level of people attending PR and its effect on their intention to use telerehabilitation (Seidman et al., 2017). Seidman and colleagues assessed the participants' demographics associated with the willingness to use telerehabilitation. Even though the main goal of Seidman et al.'s study was to only assess the level of technology engagement and its effect on the intention to use telerehabilitation, it is a key study that examined how the demographics of patients with chronic respiratory diseases might affect their intentions to use telerehabilitation. Seidman et al. concluded that the majority of PR participants who are regular users of technology were willing to use telerehabilitation. Seidman and colleagues did not measure other theoretical factors of telerehabilitation acceptance such as perceived usefulness and ease of use. In our study, we sought to examine the relationships between theoretical factors such as PU and PEOU and the intention to use telerehabilitation in addition to the effect of the demographics on the intention to use telerehabilitation. Including both the theoretical and demographic factors of telerehabilitation acceptance in our study should improve the understanding of the issue of telerehabilitation acceptance.

Telehealth and telerehabilitation acceptance among both health care practitioners and patients within the same context have not been explored to date. Rho et al. (2014) reasoned to only include physicians because they act as the gatekeepers of telemedicine and can decide whether this service can be offered for their patients. While physicians may hold the initial power in the availability of telehealth programs, measuring telehealth acceptance for both health care practitioners and patients would also provide a complete picture of the health service acceptance (Kennedy, Rogers, & Bower, 2007). Measuring telehealth acceptance of one group of the potential users may provide a fragmentary picture of the situation and partial road plan for future telehealth programs, which in return may affect telehealth program outcomes and sustainability. We sought to explore both health care practitioners' and patients' perspectives on telerehabilitation acceptance, which will be useful in meeting their needs in future telerehabilitation programs. The involvement of patients, in addition to health care practitioners, in our study is in accordance with the increasing interest of involving patients in health care decisions (Greenhalgh, 2009). Moreover, our study included theoretical variables, such as perceived usefulness and perceived ease of use, in addition to the demographics potential variables, including experience of using the Internet. Including the scale development process and the measurement of telerehabilitation acceptance of both potential users, health care practitioners and patients, makes our study a valuable addition to the literature and will provide new insights to the telerehabilitation acceptance knowledge.

**Phase I: Instrumentation.**

Our first study goal was to develop a scale to measure telerehabilitation acceptance for PR practitioners and patients. The scale development process consisted of three steps beginning with creating an item pool. Items were identified from previous studies that explored telehealth acceptance (Gagnon et al., 2012; Hu et al., 1999; Rho et al., 2014; R. Wade, Cartwright, & Shaw, 2012; Zailani et al., 2014). Then, a panel of nine experts evaluated the 36 identified items for relevance to the conceptual definition of each construct perceived usefulness, perceived ease of use, and behavioral intention to use telerehabilitation. Items with high relevance ratings were retrieved and used to form the final versions of the scale. The majority of the items were retrieved from studies that explored telehealth acceptance, which resulted in high scale validity index values.

We had initially intended that the item pool creating step to result in one scale to measure the telerehabilitation acceptance of both health care practitioners and patients. However, the experts in the content validity panel suggested writing two scales (one intended to measure acceptance of using telerehabilitation among health care practitioners and one intended to measure acceptance of using telerehabilitation among patients with chronic respiratory diseases). The decision to have two scales was based on the intent to improve clarity and precision of the items in the scale as suggested by our review experts. Writing two scales allowed us to tailor the items to target specific aspects of telerehabilitation acceptance for each population. Therefore, items retrieved from the Round 1 evaluation were listed in two scales. Each scale consisted of three subscales: perceived usefulness, perceived ease of use, and behavioral intention to use telerehabilitation.

**Phase II: Measurements of Tele-Pulmonary Rehabilitation Acceptance**

In phase II of this research project we sought to measure determinants of telerehabilitation acceptance for PR health care practitioners and patients. We utilized the two scales that were developed in phase I of this research project to collect data from health care practitioners and patients in two concurrent studies.

### Study 1: Practitioners' determinants of telerehabilitation acceptance

Our first goal in study 1 was to examine the applicability of the TAM in predicting telerehabilitation acceptance among health care practitioners working in PR. The analysis process started with examining evidence of validity of the scale, which included examining the eigenvalues for each factor in the items to determine number of constructs. The secondary goal in study 1 was to determine the predictors of high intention to use telerehabilitation among health care practitioners.

***Validity and reliability results of the health care practitioner tele-pulmonary rehabilitation acceptance scale.*** The health care practitioner telerehabilitation measuring acceptance instrument proposed in our study was examined for dimensionality. The eigenvalues for each factor in the items show that two factors had eigenvalues over Kaiser's criteria of 1, which confirms that the technology acceptance model has two different constructs: perceived usefulness and perceived ease of use. The two factors explain 63.61% of the total variance of the intention to use telerehabilitation among health care practitioners. Other studies also confirmed the discriminant validity of the TAM constructs, PU and PEOU, as suggested by Davis's (1986) original TAM (Hu et al., 1999; Kowitlawakul, 2011; Rho et al., 2014). The multidimensionality of our instrument was established through the content validity process conducted by nine experts. In Round 1 of the content validity process, the experts categorized the items based on item relevance to one of the construct's theoretical definitions. The validity was confirmed by the validity analysis conducted on the collected data.

The internal consistency reliability of our scales conducted for each subscale individually. The reliability of the subscales was supported by Cronbach's alpha values of .92, .80, and .95 for the perceived usefulness, perceived ease of use, and behavioral intention subscales, respectively. All the Cronbach's alpha values of the subscales were above the acceptable value of .70 (Field, 2013). Our findings are in agreement with the Cronbach's alpha values reported by multiple studies that examined PU and PEOU reliabilities (Hu et al., 1999; Kowitlawakul, 2011; L. Liu et al., 2015). The relatively high Cronbach's alpha values in our study can be explained by the process of creating the item pool, which was based mainly on previous studies in the telehealth acceptance literature. The experts in the content validity process extensively evaluated each item, suggested modifications, and recommended deletion of unclear items, which was reflected in the high reliability values when the participants responded to the items.

***Predictors of health care practitioners' telerehabilitation acceptance.*** Of all the participants, 79% indicated positive intention to use telerehabilitation. The high percentage of health care practitioners who are willing to use telerehabilitation, as found in our study, is a key finding. Health care practitioners reported that they are generally accepting the concept of using telerehabilitation to provide health services for their patients at home. The high percentage of telerehabilitation acceptance in our study needs to be interpreted with caution. In our study 66% of the health care practitioners had watched the telerehabilitation examples video and read the telerehabilitation brochure. The video and the brochure used to demonstrate the concept of telerehabilitation in general with no specific features that the practitioners would expect in their rehabilitation center. Only one other study has reported the percentage of telerehabilitation acceptance among health care practitioners (L. Liu et al., 2015). Liu and colleagues found that 68.24% of health care practitioners had positive intention toward using modern technologies (mechanical and computer systems) to improve patients' functions. Even though the telerehabilitation concept in Liu et al.'s study is different than the one introduced in our study, this is the only study that reported the percentage of telerehabilitation acceptance among health care practitioners before our study.

We sought to examine the predictability of the TAM constructs alone and with additional demographic predictors of the health care practitioners' intentions to use telerehabilitation. In agreement with the original TAM and previous studies, the results of our regression analysis show that the TAM constructs (PU and PEOU) alone were good at predicting the intention to use telerehabilitation. PU and PEOU explained up to 47% of the variance of the intention to use telerehabilitation among health care practitioners. In this model, only the PU was significant (OR: 17.81, $p < .01$). Our findings are similar to those of Gagnon et al. (2012) who found that a model that included PU and PEOU only was good at predicting the intention to use telehealth with 42% predictability. Hu et al. (1999) also found that PU and PEOU could explain 37% of the variance observed in the intention to use telehealth among physicians. Kowitlawakul (2011) reported that PU and PEOU could explain 44% of the variance observed in nurses' attitudes toward the eICU technology system. It worth noting that our sample included all health care practitioners working in PR, which reflects the current PR programs that include multiple health care disciplines.

Our study found that the POEU was not a significant predictor of the intention to use telerehabilitation, which contradicts what the original TAM hypothesizes. This finding is in accordance with other studies that reported the PEOU did not significantly affect the intention to use telehealth (Gagnon et al., 2012; Hu et al., 1999; L. Liu et al., 2015; Zailani et al., 2014). In our study, no telerehabilitation program was available for the participants to try. Instead, a short video that demonstrates how the telerehabilitation works was presented for all the participants to watch before taking the survey. The lack of a significant effect between the PEOU and the intention to use telerehabilitation in our findings may suggest that using a video to introduce telerehabilitation was not sufficient for the health care practitioners to realize the ease of use for telerehabilitation. It is also important to consider the variability of the PEOU of telerehabilitation for every health care specialty within the rehabilitation team. For example, physiotherapists may perceive the telerehabilitation as not easy to use considering the health services they usually provide. Our sample included all the health care practitioners working in PR, and they provide different rehabilitation services. This difference in health care specialties between the participants may affect their perceptions regarding the ease of use of telerehabilitation.

The second goal of the model-building process was to examine the effect of the additional demographic variables on the model explanatory power. In our study, we included age, experience in rehabilitation, and the type of the PR to the TAM in the first step, and gender, health care experience, health profession, working hours, and previous use of telehealth or telerehabilitation in the second step. The first group of the demographic variables improved the predictability of the model from 47% to 52%, and the second group of the variables improved the predictability of the model to be 60% of the variance of the participants' intention to use the telerehabilitation. Gagnon et al. (2012) examined the addition of other theoretical variables—such as subjective norms, facilitators, and compatibility—and found that the model gained more explanatory power (54%). Also they showed that adding other demographic variables—such as age, gender, medical specialty, number of years in clinical practice, and the highest education grade obtained—did not improve the predictability of the model. Liu et al. (2015) concluded that age, clinical experience, gender, discipline, employment status, and education level were not significantly associated with the positive intention to use telerehabilitation. In our study, age, type of the PR program, and length of experience in rehabilitation were not significantly associated with the positive intention to use telerehabilitation among health care practitioners. Even though the demographic variables were not found to be significant predictors of accepting telerehabilitation in our sample, adding age, PR type, and experience length in rehabilitation variables improved the power of the prediction model. Health care practitioners' length of experience in hospitals and previous use of telehealth were also found to be important predictors of accepting telerehabilitation. Improving the introduction methods to include hands-on workshop may decrease the level of perceived difficulty of telerehabilitation among health care practitioners. Carefully selecting the pioneers who would use telerehabilitation may also improve the probabilities for telerehabilitation to succeed. Starting telerehabilitation programs with new health care practitioners in the filed of rehabilitation could also ensure telerehabilitation success. Taking the demographic variables of the potential telerehabilitation users into the planning process is s vital factor to improve acceptance.

***Relationships between health care practitioners' telerehabilitation acceptance predictors.*** We examined multiple hypotheses about the relationships between the TAM constructs and the additional demographic variables. We hypothesized that the PU would have a significant positive effect on the intention to use telerehabilitation and that the PEOU would have a significant positive effect on the intention to use telerehabilitation. The path coefficient PU to BI ($B = 3.09$, $p < .01$) supported the first hypothesis. Similar to our findings, the PU was found to be a significant predictor of the positive intention to use telehealth or telerehabilitation in multiple studies (Hu et al., 1999; Kowitlawakul, Baghi, & Kopac, 2011; L. Liu et al., 2015; Rho et al., 2014; Zailani et al., 2014). The effect of the PEOU on the intention to use telerehabilitation was not significant ($B = 1.27$, $p < .15$). The PEOU was found to be an insignificant predictor of telehealth or telerehabilitation acceptance in many other studies as well (Gagnon et al., 2012; Hu et al., 1999; Kowitlawakul, 2011; L. Liu et al., 2015; Zailani et al., 2014). Rho et al. (2014) found that the PEOU was a significant predictor of the positive intention to use telehealth among physicians. The participants in Rho et al.'s study were mainly from a capital city where the Internet is very common, and the participants were younger in age, which may explain why they have positive perceptions about telehealth ease of use. The variability on the PEOU significance can be explained by the difference between the proposed telehealth systems in each study and the difference between the populations. The reviewed studies have measured the acceptance of different telehealth modalities on different health care practitioner groups. Previous studies that examined telehealth acceptance included participants from one or two health care professions. We measured telerehabilitation acceptance among different health care disciplines involved in PR. This feature study is unique in the literature because it reflects telerehabilitation acceptance of health professionals in modern rehabilitation programs that are multidisciplinary.

Similar to what the original TAM asserts, we hypothesized that the PEOU would have a positive significant effect on the PU of telerehabilitation. The path coefficient PEOU to PU ($B = .75$, $p < .01$) supported our hypothesis. This finding was also consistent with the conclusions from other studies (Kowitlawakul, 2011; Rho et al., 2014). However, Hu et al. (1999) found that the PEOU has no significant effect on the PU among physicians, which may suggest limitations of the TAM applicability in explaining physicians' acceptance of telehealth. In our study, only a percentage of the participants were physicians (7.4%), which may reduce the possible limitations of the TAM to explain telehealth acceptance among physicians, as suggested by Hu et al. (1999). Telerehabilitation is a multidisciplinary field of practice that includes nurses, respiratory therapists, physiotherapist, and other health care practitioners. Measuring telerehabilitation acceptance in a sample that includes different professions working in PR reflects the actual nature of PR programs. Understanding telerehabilitation acceptance of all health professions would help to design better telerehabilitation programs that suit every specialty's needs and requirements.

The age of the health care practitioner was hypothesized in our study to have a negative significant effect on the BI, the PU, and the POEU of using telerehabilitation. The results of our study show that age has no significant effects on the PU, the PEOU, or the BI of using telerehabilitation. No other studies have reported the effect of age on the intention to use telehealth or telerehabilitation among health care practitioners. It seems that age does not matter when discussing the intention to use telehealth or telerehabilitation, especially among the health care practitioners in our sample. Health care practitioners are usually required to use the technology in their daily working routines. Therefore, using telehealth or telerehabilitation might not be a new idea for them to consider and accept when the telehealth services available. Other demographic factors, such as the length of working experience or the length of experience with the Internet, may become more important and evident. Kowitlawakul (2011) concluded that the collected data did not statistically support that age, years of experience in nursing, and years of experience with computers influenced the intention to use the eICU among nurses. Age could be a critical factor in accepting the telerehabilitation in the patient population, but it does not seem to be the case for health care practitioners.

Working experience in the rehabilitation field was hypothesized in our study to have a positive significant effect on the BI, the PU, and the POEU of telerehabilitation. Our findings show that experience in the rehabilitation field was significantly associated with a negative PEOU ($B = -.16$, $p = .02$). Health care practitioners with longer working experience periods in the rehabilitation field believe that telerehabilitation would be difficult to use. Based on our data, age was not a significant negative influence on the PEOU, despite length of experience in the rehabilitation field having a negative influence. The correlation between the two variables (age and years of experience in the rehabilitation field) was positive and significant ($p < .01$). Older health care practitioners in our sample are those with longer working experience in the rehabilitation field. One explanation for this could be that the PEOU is not related to age itself or to the unfamiliarity with the technology. It is possible that working in the rehabilitation field for longer time may make it more difficult for health care practitioners to accept using telerehabilitation, even though the PU of telerehabilitation is high. Kowitlawakul (2011) found that the number of years working in the hospital had a negative statistically significant correlation with PU of telehealth among nurses, a finding different from our own. This suggests that nurses with longer working experience believe less in the usefulness of the technology. This finding highlights the importance of the method of introducing telerehabilitation to the health care practitioners in the acceptance measuring studies or before implementing a new telerehabilitation program. The introduction to telerehabilitation should outline its purpose, benefits, and features before the implementation phase, and should include hands-on workshops or risk-free trials (Tsai, 2014; R. Wade et al., 2012).

The type of the PR program was hypothesized in our study to have a significant effect on the BI, the PU, and the POEU. The idea of this inquiry was to examine whether working in a community-based, inpatient, or outpatient PR program makes a significant difference in the intention to use telerehabilitation among health care practitioners. Improving access to care for the patients and the ability to seek quick and real-time consultation from a specialized hospital may make telerehabilitation more appealing to health care practitioners working in community-based and outpatient PR programs. Our study found that working in an outpatient PR program was significantly associated with a high PU of telerehabilitation ($B$ = -.17, $p$ = .02). This suggests that health care practitioners working in outpatient PR programs believe that telerehabilitation could be beneficial for their practices and for their patients. As shown in our item analysis, health care practitioners believe that improving access to care for their patients is the major potential benefit of telerehabilitation. No other studies have examined the relationship between the type of PR program and the acceptance of using telerehabilitation. Rho et al. (2014) found that the type of hospital had a significant effect on the intention to use telehealth among physicians. The participants in Rho and colleagues' study demonstrated poor satisfaction with the accessibility to patient records, and many saw the potential for improvement in accessibility through telehealth, especially when working in rural areas. The same significant effect was not shown between the community-based PR and the PU of telerehabilitation. This absence of a significant relationship may be due to the small number of survey participants in our sample who are working in community-based PR programs (8%).

### Study 2: Patients' determinants of telerehabilitation acceptance

Our first goal in study 2 was to examine the applicability of the TAM in predicting telerehabilitation acceptance among patients attending PR programs. The analysis process started with examining evidence of validity of the scale, which included examining the eigenvalues for each factor in the items to determine number of constructs. The secondary goal in study 2 was to determine the predictors of high intention to use telerehabilitation among patients.

***Validity and reliability results of the patient tele-pulmonary rehabilitation acceptance scale.*** The patient telerehabilitation acceptance measuring scale was examined for dimensionality. We ran an initial analysis to obtain an eigenvalue for each factor in the data. As a result, the analysis revealed one factor that had an eigenvalue over Kaiser's criteria of one, and it explained 63.4% of the variance. The scree plot shows inflexion that justified retaining only one factor, which means that all the items are belonging to one construct. The eigenvalue of one and the scree plot findings of the items contradict the original TAM number of factors, which suggest two constructs within the items. Similar to our study, Tsai (2014) conducted three types of validity: content validity, convergent validity, and discriminant validity. R. Wade, Cartwright, & Shaw (2012) also developed a telehealth acceptance questionnaire based on the TAM, and found that the two scales (PU and PEOU) had good internal consistency with Cronbach's alpha coefficients of .94 and .92, respectively. None of the telehealth acceptance studies have conducted a factor analysis, and none report on the eigenvalues for the factors excluded. In our study, we examined the validity of the scale' constructs by conducting a principal axis factor analysis and by evaluating the scree plot to detect number of the extracted factors. The number of the extracted factors from our analysis is not on agreement with the one suggested by the original TAM (two constructs), therefore, further studies need to examine the validity of the TAM constructs using a principal axis factor analysis to examine the assertion of the TAM to include two constructs.

Our content validity process revealed that the tele-pulmonary rehabilitation acceptance scale items have two factors. This is also supported by the original TAM that proposed two factors (PU and PEOU). We reran the factor analysis with a predetermined two-factor solution to test the applicability of the two factors. The two-factor solution explained 70.5% of the variance. The analysis with the two predetermined factors produced higher factor loadings with promax rotation. Items in Factor 1 with high loadings represented PU, and items in Factor 2 with high loadings represented PEOU. Our final decision to have two subscales, PU and PEOU, was based on the results of the content validity assessment in phase I of our research study. The nine experts in the expert panel categorized each item to be either under PU or PEOU based on the conceptual definition of each construct. Even though having two subscales was not supported by the results of the principal axis factor analysis, we listed the items in two subscales aiming to improve the scale clarity as suggested by our review experts.

***Predictors of patients' telerehabilitation acceptance.*** Of all the patients who participated in our study, 61.2% indicated positive intention to use telerehabilitation. Recently, Seidman et al. (2017) found that 40% of patients who participated in the survey indicated a willingness to use telerehabilitation. The concept of telerehabilitation introduced in Seidman et al.'s study was identical to the one introduced in our sample. However, this study also reported that 20% of the patients were undecided about being willing to use telerehabilitation. The presence of the neutral middle choice in the Seidman et al.'s study Likert scale may cause more of the participants to choose it. The participants in our survey have four choices to choose from ranged from strongly disagree to strongly agree. We did not offer the neutral middle choice in our survey's response Likert scale. This may have forced the undecided participants in our survey to lean toward choosing agree or disagree. Another reason for the lower acceptance rate found by Seidman et al. could be the way of introducing the concept of telerehabilitation to the participants. In Seidman and colleagues' study, telerehabilitation was introduced to the participants only by a written definition with out any further information, which may have affected the participants' perceptions about telerehabilitation. In our study, we introduced telerehabilitation to the participants by two means. All the participants received copies of the telerehabilitation brochure that includes general information about telehealth and its potential benefits. After reading the brochure, each participant in our study 1 watched a short video about how the telerehabilitation works. We believe that introducing telerehabilitation to the participants using the brochure and the video have improved their understanding and perceptions about telerehabilitation.

We sought to examine the predictability of the TAM constructs alone and with additional demographic predictors of the patients' intentions to use telerehabilitation. In agreement with the original TAM (F.D. Davis, 1985), the results of our regression analysis shows that the TAM constructs (PU and PEOU) alone were good in predicting the intention to use telerehabilitation. PU and PEOU explained up to 24% of the variance of the intention to use telerehabilitation among patients. In this model, only the PU was a significant predictor (OR: 6.46, p = .04). The PEOU was not a significant predictor of the intention to use telerehabilitation among patients in our study ($\beta = .47$, $p = .57$). Multiple telehealth acceptance studies found that both perceived usefulness (PU) and perceived ease of use (PEOU) had significant positive effects on the intention to use telehealth among patients (Cimperman et al., 2016; Diño & de Guzman, 2015; Tsai, 2014). In contrast to our findings, Cimperman et al. (2016), Tsai (2014), and Diño and de Guzman (2015) found that effort expectancy (ease of use) had a significant influence on the intention to use telehealth. The participants in both Tsai (2014) and Diño and de Guzman (2015) studies had the opportunity to try telehealth for approximately 30 days, which offered theme a clear idea about telehealth ease of use before taking the survey. It seems that introducing telerehabilitation to the participant via watching video was not enough for them to apprehend the telerehabilitation level of difficulty, which may explain why PEOU was not a significant factor of using telerehabilitation.

The second goal of our model-building process was to examine the effect of the additional demographic variables on the model explanatory power. We included age, duration of the disease, and travel time to the PR center in the first step. The second model-building step included Internet usage experience, education level, transportation to the PR center type, household income, and PR services payment type.

The model did not improve significantly with the inclusion of the following variables age, duration of the disease, and travel time to the PR center. However, the percentage of the total variance explained by the model improved from 24% to 30%. Considering age, disease duration time, and travel time to the PR center seems to be beneficial in understanding the intention to use telerehabilitation. It seems that adding the three demographic variables may improve our prediction of who could use telerehabilitation in the future. The second group of the demographics, Internet usage experience, education level, transportation to the PR center type, household income, and PR services payment type did not significantly improve the percentage of the variance explained by the model. The percentage of the total variance explained by the model improved to 47%. Other studies also examined the influence of the demographic variables on the acceptance of telehealth. Diño and de Guzman (2015) examined the relationship between gender and the intention to use telehealth, and found no significant change when gender was added to the model. In addition, Cimperman et al. (2016) found that the level of education and gender variables had no significant influence on the intention to use telehealth. Even though we did not find the demographic variables of the patients to be significant predictors of the positive intention to use telerehabilitation, adding the demographic variables to the model improved its predictability of using telerehabilitation.

***Relationships between patients' telerehabilitation acceptance predictors.*** We examined multiple hypotheses about the relationships between the TAM constructs (PU and PEOU) and additional demographic variables (age, disease duration time, and travel time to the PR center). We hypothesized that the PU would have a significant positive effect on the intention to use telerehabilitation and that the PEOU would have a significant positive effect on the intention to use telerehabilitation. The path coefficient PU to BI ($B = 1.88$, $p < .01$) supported the first hypothesis. The same conclusion was also reached in other studies regarding the positive significant effect of the PU on the intention to use telehealth (Cimperman et al., 2016; Diño & de Guzman, 2015; Tsai, 2014). Perceived usefulness of telerehabilitation has a significant influence on the intention to use telerehabilitation. It seems that the potential benefits of telerehabilitation such as decreasing transportation difficulties will encourage patients to consider using telerehabilitation in the future.

The PEOU was found to have no significant effect on the intention to use telerehabilitation in our study ($\beta = .89$, $p = .20$). In contrast, many studies in the telehealth acceptance literature found that the PEOU (effort expectancy) had a positive significant effect on the intention to use telehealth (Cimperman et al., 2016; Diño & de Guzman, 2015; Tsai, 2014). In two of these studies, the participants had used the telehealth systems for 30 days (Diño & de Guzman, 2015; Tsai, 2014). Previous use of telehealth may caused the participants' PEOU in Diño & de Guzman (2015) and Tsai

(2014) studies to be incomparable to the PEOU in our study that measured the concept of telerehabilitation in general with no specific technology. Cimperman et al. (2016) introduced telehealth in a procedure similar to ours and provided a graphical presentation of the telehealth concept with a list of key functionalities with each survey. The PEOU was found to be a significant predictor of the intention to use telehealth ($\beta = .52, p < .01$) (Cimperman et al., 2016). Patients still consider telerehabilitation ease of use and learning to use it as very difficulty, which deceased their intentions to use it when available.

Measuring the PEOU of the telehealth concept is complicated. The proposed telehealth system needs to be available for trials or at least to provide enough information for the participants about how the proposed system will function. We introduced the concept of telerehabilitation by two means. Every participant in our study was required to read a telerehabilitation brochure that included general information about telehealth and the potential benefits of telerehabilitation. All the participants were advised to watch a short video demonstrating how telerehabilitation works. We believe that the addition of the video as a way to introduce telerehabilitation to the participants was easy to conduct and provided a quick and cost effective method of introducing telerehabilitation.

The age of the patient was hypothesized in our study to have a negative significant effect on the BI, the PU, and the POEU of using telerehabilitation. The results of our study show that age has a significant negative effect on the PEOU of telerehabilitation ($\beta = -.12, p = .03$). However, Cimperman et al. (2016) tested the influence of age on the intention to use telehealth and found no significant influence ($\beta =$

-.03, $p > .05$). The effect of age was negative on the intention to use telehealth. Our finding suggests that the POEU of telerehabilitation is affected by the age of the patient. Due to the effects of aging, which includes physical and cognitive limitations, low confidence, and difficulties in comprehension, elderly patients may face difficulties when using the information technologies (Wang, Rau, & Salvendy, 2011). Studies also show that age is negatively associated with the Internet use (J. Chang, McAllister, & McCaslin, 2015). We examined the effect of the length of Internet experience and found that years of Internet experience was a significant predictor of the positive intention to use telerehabilitation (Wald = 5.82, $p = .05$). Patients who experienced the Internet showed positive intention toward using telerehabilitation compared with patients who never used the Internet. Considering the needs of the older adults when designing telerehabilitation programs will improve acceptance and compliance with the service. Future telerehabilitation programs with age appropriate interfaces that include easy navigation screens, sound activated features, and light-weight devices will make it easer for older adults to accept telerehabilitation. Also, future telerehabilitation programs can utilize the advances in robots. A health care practitioner driven robot that carries the telerehabilitation monitoring device can be used to go to the patient's home to conduct the PR session (Chung, Grathwohl, Poropatich, Wolf, & Holcomb, 2007; Linder et al., 2015). Such technology will eliminate the needed skills to operate the telerehabilitation devices because the device will be controlled totally by the distant health care provider. Taking in consideration the physical and mental conditions of older adults when using telerehabilitation into the design will decrease their perceived difficulties of telerehabilitation.

Disease duration was hypothesized to have a significant effect on the BI, the PU, and the POEU of using telerehabilitation. Regression analyses show that the influence of the length of contracting the chronic respiratory disease has no significant influence on the PU, the POEU, and the intention to use telerehabilitation. However, the results show that the relationship between length of contracting the respiratory disease was negatively associated with PU, POEU, and intention to use telerehabilitation. This suggests that the longer the respiratory disease duration, the less the patients would accept using telerehabilitation. The negative association between length of contracting the disease and PU, PEOU, and BI can be explained by age. Aging related changes including the disease progression may have affected patients' perception about telerehabilitation.

Distance from the PR center was hypothesized to have a significant effect on the BI, the PU, and the POEU of using telerehabilitation. Telehealth was introduced as a solution to the barriers of receiving health care services, such as transportation difficulties and living in a rural area (Keating et al., 2011; Young et al., 1999). None of the proposed hypotheses regarding the effect of the distance on the intention to use telerehabilitation were supported by our data. The goal of this inquiry was to investigate whether living in a rural area or far away from the PR center, or having transportation difficulties may affect the acceptance of receiving rehabilitation services at home via telerehabilitation. Our data shows that most participants in our study sample (88.6%) are using their own cars to reach the PR center. The majority of the participants in our study (53%) indicated that it takes between 16 to 30 minutes for them to reach the PR center from their homes. Both factors suggest that patients who participated in our study have no difficulties with transportation to the PR center, which affected their perceptions about telerehabilitation.

The participants’ responses show that 57.5% of the patients strongly agreed that telerehabilitation could eliminate the transportation difficulties in getting to the PR center. This high percentage indicates that patients still strongly believe in the potential benefits of telerehabilitation even though they may not consider using it in the present time. No other studies have examined the effect of distance factor or the type of transportation on patients’ acceptance of using telehealth. Absence of transportation was found as a reason for not receiving health care services for 9% of patients aged 65 and older (Smith, 2008). Keating et al. (2011) also reported that unavailability of transportation was one of the reasons for not attending PR sessions for patients (Keating et al., 2011). Living in areas far away from the PR center was not a significant factor to accept telerehabilitation for the patients in our study. Living in rural areas is associated with poorer access to medical care and fewer physician visits (Caldwell, Ford, Wallace, Wang, & Takahashi, 2016). For example, in Australia, the percentage of COPD patients living in rural and remote areas is higher than in major cities (Johnston, Maxwell, Maguire, & Alison, 2012). Using telerehabilitation could be a solution to improve access to care for patients living in remote areas or for patients with limited access to care. Future studies need to explore the influence of living away from the PR center on telerehabilitation acceptance in other geographic areas rather than the Sate of Indiana and in different countries where transportation is very difficult.

## Limitations

There were several limitations in our study despite the novel findings from the scale development process and from the two studies. First, the findings from the scale development study may be challenged because two of the experts from the Round 1 evaluation did not return the Round 2 evaluation forms. This may have affected the degree of agreement from Round 1 to Round 2. The review panel in Round 2 still included experts with similar expertise comparable to the panel in the Round 1, which hopefully minimized the effect of loosing feedback from two experts. While the initial plan was to meet each expert to explain the goal and the content evaluation steps before starting the content validity process, meeting all the reviewers was not achievable because of geographical and time barriers. Two reviewers met in person while the remaining two interviewed in phone calls meeting.

The two acceptance studies also faced limitations. Even though the survey was available online for the participants, the number of health care practitioners who participated in the survey (N = 222) was below the hoped for number. Considering the number of health care practitioners working in PR centers is very small. Usually only one to four health care practitioners are working in every cardiopulmonary rehabilitation center, and not all of them are involved with the pulmonary rehabilitation program. The same limitation was also present when recruiting participants for the patient telerehabilitation acceptance study. The number of patients regularly attending the IU Health PR centers ranged from 10 to 40 patients in a single week. Patients come to the PR centers twice a week for almost an hour, and those attending usually suffer from respiratory conditions that may limit their abilities to talk freely before the session or especially after the exercise session. Patients' limited time or exertion feeling after the PR sessions explain why some patients refused to take our survey. Additionally, the investigator had only limited access to some IU Health cardiopulmonary rehabilitation centers and the Community Hospital East Indianapolis. This may have made the sample less diverse with limited generalizability of the conclusions beyond the state of Indiana in the United Sates.

Another limitation in our study was the approach of introducing telerehabilitation to the participants. The only available method of introducing telehealth and telerehabilitation was through showing the participants a short video demonstrating how telerehabilitation works. In addition, a copy of the telerehabilitation brochure that includes information about telehealth and its benefits was provided for each participant. These two methods were chosen because no telerehabilitation program was available for the participants to try before taking the survey. The method of introducing telerehabilitation to the participants may have provided an incomplete picture of the concept of telerehabilitation to the participants and may have affected their responses. Despite some of the limitations that were faced, we believe that this study will contribute to the literature of telerehabilitation acceptance by closing some of the knowledge gaps. We confirmed the usefulness of the TAM in explaining telerehabilitation acceptance among PR users. We also identified the main demographics that may influence telerehabilitation acceptance of health care practitioners and patients.

## Future Research

Based on the process of conducting this research, there are few suggestions that could benefit future studies measuring telehealth acceptance. Future studies may consider using other theoretical frameworks for the measurement instrument. More knowledge can be gained by either extending the technology acceptance model with additional theoretical variables, such as the social influence, or by utilizing other models, such as the health believe model. Other variables that may affect the acceptance of using telerehabilitation also need to be studied—for instance, the effect of the culture, especially in populations new to the technology. Future studies can also consider exploring telerehabilitation acceptance in other countries where access to health care (e.g., rehabilitation services) is limited or in countries where transportation is inadequate and difficult.

Qualitative inquiry methods would benefit future studies exploring telerehabilitation acceptance. The addition of open-ended questions would add useful knowledge to enhance the understanding of telerehabilitation acceptance and could improve the existing theoretical models. Qualitative methods would also shed light on some acceptance issues that are subjectively important to telerehabilitation users (Whitten & Richardson, 2002). Telehealth acceptance literature includes multiple studies that explore users' acceptance using qualitative methods (Buckley, Tran, & Prandoni, 2004; Dinesen et al., 2013; Mair et al., 2008; Sharma et al., 2010; Taylor et al., 2015; V. A. Wade et al., 2014). These qualitative studies explored additional variables that might influence telehealth acceptance such as trust and confidence in telehealth. Future studies exploring telerehabilitation acceptance can use similar qualitative methods to enhance telerehabilitation acceptance understanding.

**Implications on the Health Care Services**

Our research findings have many implications for the field of telerehabilitation and health care services in general. For health care organizations planning to start telerehabilitation, it will be essential to consider the significant intention to use telerehabilitation predictors found in this study. Considerations when starting a telerehabilitation program should include the telerehabilitation program design aspects and the selection of the targeted population for the new program. New telerehabilitation programs need to consider that usefulness of telerehabilitation is the key factor in accepting the system. Starting programs need not only to have the potential of being more beneficial than the traditional rehabilitation programs but also to present the clinical benefits of telerehabilitation to health care practitioners and patients. Potential benefits of telerehabilitation—such as the time savings, improving access to care, providing quick care, facilitating monitoring, and improving communication with patients—should be presented with empirical data or via pilot studies to the health care practitioners. Patients also need to know that telerehabilitation has the potential to improve their access to care, improve attendance and adherence, reduce transportation difficulties, and improve communication with health care providers. The benefits of the telerehabilitation need to be presented by all means available, including presentations, hands-on workshops, and risk-free trials. Ultimately, telerehabilitation potential benefits will not be realized if both health care practitioners and patients are unwilling to utilize it. Therefore, effective introduction and roll out of telerehabilitation programs are the key to succeed.

Ease of use is the other major factor that health care organizations should consider when introducing new telerehabilitation programs (Taylor et al., 2015). New telerehabilitation programs need to be user-friendly and need to accommodate various levels of user abilities and needs. One important point that the participants in our study stated is that they expecting telerehabilitation to be difficult to learn. This suggests that, when introducing a new telerehabilitation program, health care organizations should first utilize teaching sessions and hands-on workshops before the actual usage of the telerehabilitation. Especially for health care practitioners with long experience periods in the rehabilitation field, the ease of using telerehabilitation needs to be presented clearly and should cover all the needed and required new skills to use the telerehabilitation. Finally, it is very essential for new telerehabilitation systems' designers to consider aspects of using technology for elderly patients. Older adults may suffer from physical limitations such as poor vision and decreased precision, which make the interaction with telerehabilitation equipment to be difficult. Also, cognitive limitations of older adults such as poor memory and slower response should be considered when designing telerehabilitation equipment (Wang et al., 2011).

# Chapter VI: Conclusion

Using telerehabilitation is a new practice within physical medicine and rehabilitation. Telerehabilitation can be used to help PR programs improve access for patients living in rural areas and achieve better outcomes by improving patients' adherence. Understanding the factors that will affect potential users in their decision to use or not use telerehabilitation is a key factor to success. We examined the detriments of the positive intention to use telerehabilitation among health care practitioners and patients. The process started with an instrument development study, which included content and face validity assessments. The results of phase I of our study provide evidence of content and face validity of the Tele-Pulmonary Rehabilitation Scale. The content and face validity assessments produced two scales: one scale with 13 items to measure telerehabilitation acceptance among patients with chronic respiratory diseases and one scale with 17 items to measure telerehabilitation acceptance among health care practitioners working in PR programs. The Tele-Pulmonary Rehabilitation Scale provides a standardized data collection tool to measure telerehabilitation acceptance among potential users. Since using telerehabilitation is still a new field of practice, measuring its acceptance is an essential step before starting the clinical applications. Measuring acceptance among patients and health care practitioners will help to assure successful implementation and positive outcomes of future telerehabilitation programs.

To address this needed first step, two scales were developed in the first phase and have been used to collect participants' responses in two studies. Participants in study 1 consisted of health care practitioners working in traditional PR programs. Participants in study 2 were patients attending PR programs.  A series of descriptive analyses were first conducted in each study to explore the participants' demographics and the item analysis. The second analyses step aimed to telerehabilitation acceptance factors for each participant group.  The results from the two studies show that factor analysis was appropriate to conduct based on the sample size, and both scales show signs of internal consistency based on the Cronbach's alpha values.

Multiple logistic regression analyses were conducted to identify telerehabilitation acceptance variables of health care practitioners working in PR.  Logistic regression outcomes in study 1 confirmed the TAM practicality in predicting telerehabilitation acceptance for health care practitioners.  Perceived usefulness was a significant predictor of using telerehabilitation.  Potential telerehabilitation benefits (e.g. the ability to improve access to health care and improving patient monitoring) were considered as the main benefits of telerehabilitation.  Logistic regression determined additional variables age, experience in rehabilitation, and type of PR program increased the TAM predictability of positive intention to use telerehabilitation among health care practitioners.  Additional practitioners demographic variables gender, health care experience, health profession, working hours, and previous use of telehealth or telerehabilitation also improved the predictability of the TAM.

Multiple logistic regression analyses were conducted to identify telerehabilitation acceptance variables of patients in PR.  Logistic regression outcomes in study 2 confirmed the TAM practicality in predicting telerehabilitation acceptance for patients with chronic respiratory diseases.  Perceived usefulness was a significant predictor of using telerehabilitation. Potential telerehabilitation benefits (e.g. eliminating transportation difficulties and improving access to rehabilitation services) were considered as the main potential benefits of telerehabilitation by patients. Logistic regression outcomes also show that additional variables age, disease duration, and distance from the PR center increased the TAM predictability of positive intention to use telerehabilitation among patients. Additional patient demographic variables Internet experience, education level, type of transportation to the PR center, household income, and PR services payment type also improved the predictability of the TAM.

This is the first study to develop and validate a psychometric instrument to measure telerehabilitation acceptance among health care practitioners working in PR and patients attending PR. The outcomes of our study elucidate telerehabilitation acceptance for key stakeholders planning to start telerehabilitation. Future studies must focus on extending the TAM or try to build new models that could explain the acceptance of using telerehabilitation among health care practitioners and patients. Future studies could also consider adding a qualitative element so that the outcomes could more accurately capture people's experiences.

## Appendix A

### Tele-Pulmonary Rehabilitation Acceptance Scale: Experts' Content Validity

As telehealth usage in health care become more popular, the need for a valid and a reliable measurement tool has a greater significance for clinicians, managers, and patients with chronic respiratory diseases. I am in the process of developing an instrument to measure health care providers' and patients' acceptance of using telehealth to provide and receive pulmonary rehabilitation services.

You are asked to serve as a content expert because of your own experience in the health services research. Your participation in validating this tool is very valuable, and it will set the stage for future studies that investigate the use of telehealth technology in rehabilitation programs. This preliminary scale consists of 2 sections:

- Items related to the two constructs: *perceived usefulness* (PU), *perceived ease of use* (PEOU). And items to measure the dependent variable " Behavioral *Intention"* (BI).
- Demographic data.

**Instructions on how to evaluate the scale's items:**

The content validity assessment will include 1) locating each item in section 2 to one of the 2 categories: 1= perceived usefulness (PU), 2= perceived ease of use (PEOU), 2) rating each item on a four-point scale according to your opinion on the degree of relevance to the construct it belongs into, and 3) evaluating the appropriateness of the demographics items and their clarity.

| **Evaluator's Name:** |
|---|
| **Position/Department:** |

## Section 1: Tele-Pulmonary Rehabilitation Acceptance Items

| | | |
|---|---|---|
| Operational definitions of the constructs | Perceived Usefulness (PU) | The degree to which a user believes that using telerehabilitation will be associated with clinical and other benefits. |
| | Perceived Ease of Use (PEOU) | The degree to which a telerehabilitation user believes that using a telerehabilitation would be free of effort. |

| | |
|---|---|
| For each item, please choose a category that you believe the item belongs to<br>(1) Perceived Usefulness (PU) or<br>(2) Perceived Ease of Use (PEOU). | Please indicate the level of relevance of each item to its category.<br>1 = Not Relevant<br>2 = Relevant, Need of major revision<br>3 = Moderately Relevant, Need of minor revision<br>4 = Very Relevant, no modification. |

| | | Please choose one category only | | Please choose one level of relevance | | | | |
|---|---|---|---|---|---|---|---|---|
| | Preliminary Items | 1= PU | 2= PEOU | NR 1 | R 2 | MR 3 | VR 4 | Evaluator's Suggestions |
| 1 | Telerehabilitation will allow me to accomplish my tasks more quickly. | PU ☐ | PEOU ☐ | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 2 | Telerehabilitation will allow me to accomplish more than face-to-face rehabilitation. | PU ☐ | PEOU ☐ | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 3 | Telerehabilitation will give me greater control over the disease symptoms. | PU ☐ | PEOU ☐ | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 4 | Telerehabilitation will | PU | PEOU | 1 | 2 | 3 | 4 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | safe me time. | | | | | | | | |
| 5 | Telerehabilitation will be flexible to interact with. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 6 | Telerehabilitation will improve access to the rehabilitation program. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 7 | Learning to operate the telerehabilitation equipment would be easy for me. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 8 | It will be easy to get the telerehabilitation to do what I want it to do. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 9 | My interaction with the telerehabilitation equipment will be clear. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 10 | I will find telerehabilitation easy to use. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 11 | Providing/ Receiving pulmonary rehabilitation services using telerehabilitation will be more convenient. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 12 | Using telerehabilitation technology will be understandable. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 13 | Telerehabilitation will meet my needs. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 14 | Telerehabilitation will improve my performance. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 15 | Telerehabilitation will increase the quality of the pulmonary rehabilitation services. | PU | PEOU | | 1 | 2 | 3 | 4 | |
| 16 | Telerehabilitation will improve the attendance in the rehabilitation | PU | PEOU | | 1 | 2 | 3 | 4 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | program. | | | | | | | | |
| 17 | Telerehabilitation will overcome transportation difficulties when going to the rehabilitation center. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 18 | It will be easy for me to become skillful in using the telerehabilitation. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 19 | Telerehabilitation will decrease the cost of the rehabilitation program. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 20 | Using telerehabilitation would be simple. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 21 | Telerehabilitation will facilitate the monitoring of the disease. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3☐ | 4 ☐ | |
| 22 | Telerehabilitation will give me the feeling of being safe. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 23 | Telerehabilitation will improve the rehabilitation plan. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 24 | Telerehabilitation will give me the feeling of being continuously monitored. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 25 | Telerehabilitation could help me provide/ receive intervention more quickly. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3☐ | 4 ☐ | |
| 26 | Education sessions will be easier when using telerehabilitation. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 27 | Telerehabilitation is useful in the rehabilitation program. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 28 | Telerehabilitation will save me time of | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | travelling to the health care center. | | | | | | | | |
| 29 | Telerehabilitation will improve the relationship between the health care provider and the patient. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 30 | Telerehabilitation does not require a lot of my mental effort. | PU ☐ | PEOU ☐ | | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Intention to use the telerehabilitation: The likelihood of using telerehabilitation by health care providers and patients. | | | | | | |
| | | | | | | |
| Intention measuring Items | | Please choose one level of relevance | | | | |
| | | NR 1 | R 2 | MR 3 | VR 4 | Evaluator's Suggestions |
| 1 | I am positive toward using the telerehabilitation. | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 2 | I will use the telerehabilitation when it becomes available. | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 3 | I am willing to use telerehabilitation to provide/receive pulmonary rehabilitation services. | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 4 | I will use the telerehabilitation to provide/receive pulmonary rehabilitation services as often as needed. | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 5 | I will use the telerehabilitation to provide/receive pulmonary rehabilitation services rather than the traditional face-to-face sessions. | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |
| 6 | I will usually use telerehabilitation. | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | |

What is the best response format to Intention items? Please choose the preferred format of the following

| | | |
|---|---|---|
| ☐ 4-point Likert scale | ☐ Two choices: YES or NO | ☐ Other format: |

Please suggest additional items:

| | | | | | |
|---|---|---|---|---|---|
| | | PU ☐ | PEOU ☐ | BI ☐ | |

**Section 2: Demographic data items.**

| Questions: | Response Format | Evaluator's Suggestions |
|---|---|---|
| Age | Blank (……………) | |
| Gender | ☐ Female<br>☐ Male | |
| Race and ethnicity | ☐American Indian or Alaskan Native<br>☐Asian or Pacific Islander<br>☐Black, not of Hispanic origin<br>☐Hispanic<br>☐White, not of Hispanic origin. | |
| Level of education | Blank (……………) | |
| Number of years working in PR (for health care providers) | Blank (……………) | |
| How would you rate your competence of computers? | ☐Absolute beginner<br>☐Some competence<br>☐Average competence<br>☐Good competence<br>☐Expert | |
| Area of residence (For patients). | ☐Inside metropolitan area<br>☐Outside metropolitan area | |
| Type of the PR program (For the health care providers) | ☐Home-based<br>☐Community based<br>☐In-patient program | |
| Please suggest additional variables to be collected with the scale. | | |

**Appendix B**

**Validating the Contents of the Tele-Pulmonary Rehabilitation Acceptance Scale**

(Round 2 of the Delphi data collection processes)

**Dear. ………………,** for the final step of my scale content validation, please answer the following 3 questions regarding the telerehabilitation acceptance scale development:

**1- What do you recommend in regards to creating the telerehabilitation acceptance scale(s) for both health care providers and patients?**

☐ Creating 2 versions of the scale; 1 for health care providers and 1 for patients that will be easier to read and clearer in terms of wording.

☐ Using one scale for both health care providers and patients that will be clear in terms of wording.

Additional comments:

**2- For telerehabilitation introduction, what do you recommend for introducing telerehabilitation to the participants?**

☐ Showing the participants the Telerehabilitation Example Video on YouTube will be enough.

☐ Having the participants read the Telerehabilitation Information Brochure will be enough.

☐ The participants need to see the video and read the Telerehabilitation Information Brochure.

Additional comments:

3- Please review each of the following sets of items and evaluate them for inclusion or exclusion from the final versions of the scales.

**A- Tele-Pulmonary Rehabilitation Acceptance Scale**

**(Patients Version)**

| The following items were selected and categorized based on the review panel evaluations. Please evaluate each item to be included or not in the final version of the scale. | | | | |
|---|---|---|---|---|
| **Perceived Usefulness (PU) of Telerehabilitation** | | **Inclusion** | | **Comments** |
| 4 | Telerehabilitation will save me time | ☐ Yes | ☐ No | |
| 6 | Telerehabilitation will improve my access to the rehabilitation programs. | ☐ Yes | ☐ No | |
| 16 | Telerehabilitation will improve my attendance in the rehabilitation program | ☐ Yes | ☐ No | |
| 17 | Telerehabilitation will eliminate transportation difficulties in getting to the rehabilitation center | ☐ Yes | ☐ No | |
| 24 | Telerehabilitation will give me the feeling of being continuously monitored | ☐ Yes | ☐ No | |
| 25 | Telerehabilitation could help me to receive care more quickly at home | ☐ Yes | ☐ No | |
| 27 | Telerehabilitation will be useful in the rehabilitation program | ☐ Yes | ☐ No | |
| 29 | Telerehabilitation will improve my communication with the health care provider | ☐ Yes | ☐ No | |
| **Perceived Ease of Use (PEOU) of Telerehabilitation** | | **Inclusion** | | **Comments** |
| 5 | Telerehabilitation will be flexible to use | ☐ Yes | ☐ No | |
| 7 | Learning to operate the telerehabilitation equipment will be easy for me | ☐ Yes | ☐ No | |
| 10 | Telerehabilitation will be easy to use | ☐ Yes | ☐ No | |
| 11 | Receiving pulmonary rehabilitation services at home using telerehabilitation will be more convenient | ☐ Yes | ☐ No | |
| 18 | It will be easy for me to become skillful in using telerehabilitation equipment | ☐ Yes | ☐ No | |
| 20 | Using telerehabilitation will be simple | ☐ Yes | ☐ No | |
| 26 | Education sessions will be easier when using telerehabilitation | ☐ Yes | ☐ No | |
| **Behavioral Intention (BI) to Use Telerehabilitation** | | **Inclusion** | | **Comments** |
| 1 | I feel positive about using telerehabilitation. | ☐ Yes | ☐ No | |
| 2 | I will use telerehabilitation when it becomes available in my rehabilitation center | ☐ Yes | ☐ No | |
| 3 | I will plan to use telerehabilitation to receive pulmonary rehabilitation services | ☐ Yes | ☐ No | |
| 4 | I will use telerehabilitation to receive pulmonary rehabilitation services as often as recommended by my provider. | ☐ Yes | ☐ No | |

**B- Tele-Pulmonary Rehabilitation Acceptance Scale**

**(Health Care Providers Version)**

| The following items were selected and categorized based on the review panel evaluations. Please evaluate each item to be included or not in the final version of the scale. | | | | |
|---|---|---|---|---|
| **Perceived Usefulness (PU) of Telerehabilitation** | | **Inclusion** | | **Comments** |
| 4 | Telerehabilitation will save me time | ☐ Yes | ☐ No | |
| 6 | Telerehabilitation will improve patients' access to rehabilitation programs | ☐ Yes | ☐ No | |
| 16 | Telerehabilitation will improve patients' attendance in the rehabilitation program | ☐ Yes | ☐ No | |
| 21 | Telerehabilitation will facilitate monitoring of the patients' disease symptoms | ☐ Yes | ☐ No | |
| 25 | Telerehabilitation could help me to provide care more quickly for patients at home | ☐ Yes | ☐ No | |
| 27 | Telerehabilitation will be useful in the rehabilitation program | ☐ Yes | ☐ No | |
| 29 | Telerehabilitation will improve my communication with the patients | ☐ Yes | ☐ No | |
| 31 | Telerehabilitation will facilitate monitoring of the patients' daily activities | ☐ Yes | ☐ No | |
| **Perceived Ease of Use (PEOU) of Telerehabilitation** | | **Inclusion** | | **Comments** |
| 5 | Telerehabilitation will be flexible to use | ☐ Yes | ☐ No | |
| 7 | Learning to operate the telerehabilitation equipment will be easy for me | ☐ Yes | ☐ No | |
| 10 | Telerehabilitation will be easy to use | ☐ Yes | ☐ No | |
| 11 | Providing pulmonary rehabilitation services using telerehabilitation will be more convenient | ☐ Yes | ☐ No | |
| 18 | It will be easy for me to become skillful in using telerehabilitation equipment | ☐ Yes | ☐ No | |
| 20 | Using telerehabilitation will be simple | ☐ Yes | ☐ No | |
| 26 | Education sessions will be easier when using telerehabilitation | ☐ Yes | ☐ No | |
| **Behavioral Intention (BI) to Use Telerehabilitation** | | **Inclusion** | | **Comments** |
| 1 | I feel positive about using telerehabilitation | ☐ Yes | ☐ No | |
| 2 | I will use telerehabilitation when it becomes available in my rehabilitation center | ☐ Yes | ☐ No | |
| 3 | I will use telerehabilitation to provide pulmonary rehabilitation services | ☐ Yes | ☐ No | |
| 4 | I will use telerehabilitation to provide pulmonary rehabilitation services as often as recommended by the care team. | ☐ Yes | ☐ No | |

## Appendix C

## Telerehabilitation information brochure (Health care practitioners)

# Tele-Rehabilitation

**This brochure explains new ways of providing rehabilitation services for patients at home**

### What is Tele-Rehabilitation?

- Tele-Rehabilitation is an emerging technology used to facilitate the delivery of rehabilitation services at a distance using the Internet and computer devices.
- Tele-Rehabilitation could be used to provide equitable access to patients who are geographically remote and those who are physically and economically disadvantaged; it also has the capacity to improve the quality of rehabilitation services.

### Benefits of Tele-Rehabilitation:

- Tele-Rehabilitation will allow immediate access to rehabilitation services even if a patient is living far away from a health care center.
- Providers can serve more patients, thus overcome providers shortages.
- Tele-Rehabilitation can help to improve communication with patients.
- Using Tele-Rehabilitation will save you time, and allow flexibility in your daily routine.

- **To learn more about Tele-Rehabilitation, watch the <u>Tele-Rehabilitation in the Home - Clinical examples</u> in YouTube.**
- **For more information about Telehealth and Telerehabilitation visit the following web page:**
- http://www.hrsa.gov/healthit/toolbox/RuralHealthITtoolbox/Telehealth/whatistelehealth.html

**Telerehabilitation information brochure (Patients)**

# Tele-Rehabilitation

**This brochure explains new ways of getting rehabilitation services at home in the future**

## What is Tele-Rehabilitation?

- Tele-Rehabilitation is the delivery of rehabilitation services at a distance using the Internet.
- Tele-Rehabilitation uses video conferencing technology to conveniently, securely, and quickly provides you with access to rehabilitation services while you are at home.
- Tele-Rehabilitation allows for real-time interaction between patients and health providers.
  Specialty equipment provides a safe, reliable and accurate way for provider to assess a patient and manage their treatment without physically being in the same location.

## What makes Tele-Rehabilitation so valuable?

- Tele-Rehabilitation allows quick access to rehabilitation services.
- Tele-Rehabilitation saves you the cost and time of traveling to the medical center.
- Danger of traveling to the rehabilitation center can be avoided.
- Using Tele-Rehabilitation to monitor your vital signs allows your doctor to take action before your condition worsens.

- To learn more about Tele-Rehabilitation, watch the **Tele-Rehabilitation in the Home - Clinical examples** in YouTube.
- For more information about Telehealth and Telerehabilitation visit the following web page:
- http://www.hrsa.gov/healthit/toolbox/RuralHealthITtoolbox/Telehealth/whatistelehealth.html

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